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U.S. Army Environmental Center

FINAL
PHASE I SITE INSPECTION REPORT FOR SITES IDENTIFIED IN THE 1994 PRELIMINARY ASSESSMENT REPORT AND AREAS OF CONCERN 3, 8, 9 FORT ALLEN JUANA DIAZ, PUERTO RICO

VOLUME I OF II

TEXT, FIGURES AND TABLES

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PRELIMINARY ASSESSMENT REPORT AND
AREAS OF CONCERN 3, 8, 9
FORT ALLEN
JUANA DIAZ, PUERTO RICO

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JANUARY 1997

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FORMER NAVY LANDFILL (AREA OF CONCERN 1)

FORMER IMMIGRATION AND NATURALIZATION SERVICE LANDFILL (AREA OF CONCERN 2)

BUILDING 342 - ORGANIZATIONAL MAINTENANCE SHOP (OMS#9)

BUILDING 358 - PAINT AND CHEMICAL STORAGE ROOM

BUILDING 360 - PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

LEAKING ELECTRICAL TRANSFORMER

UNDERGROUND STORAGE TANKS

ABOVEGROUND STORAGE TANKS

WASTEWATER TREATMENT PLANT (WWTP)

AREA OF CONCERN 3 - HISTORIC TRENCHES AND RCRA LANDFILL

AREA OF CONCERN 8 - FORMER STORAGE AREA

AREA OF CONCERN 9 - POTENTIAL HISTORIC DISPOSAL SITE

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

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EXECUTIVE SUMMARY

The U.S. Army Environmental Center (USAEC) contracted ABB Environmental Services, Inc. (ABB-ES), under Contract No. DAAA15-91-D-0008, to conduct Phase I Site Inspections (SIs) at Fort Allen in Juana Diaz, Puerto Rico.

Two separate environmental assessments/investigations have identified potential waste sources and areas of concern (AOCs) at Fort Allen. The first is a Preliminary Assessment (PA) of the Army National Guard Facility, Fort Allen (Weston, R.F., 1994). The second is a Site Investigation, completed in July 1996 by the U.S. Army Terrain Analysis Center (USARTAC, 1996).

The PA identified a total of nine potential waste source areas:

- Former Navy Landfill
- Former Immigration and Naturalization Service (INS) Landfill
- Organizational Maintenance Shop #9 (OMS #9)
- Paint and Chemical Storage Room, Building 358
- Pesticide/Herbicide Mixing and Storage Area
- Electrical Transformers
- Underground Storage Tanks (USTs)
- Aboveground Storage Tanks (ASTs)
- Wastewater Treatment Plant (WWTP)

In response to U. S. Environmental Protection Agency (USEPA) Region II's request that an SI be performed at Fort Allen, the National Guard Bureau (NGB) enlisted the aid of the USAEC to delineate the scope of the SI and to contract Phase I to ABB-ES. To complete the process of identifying potential waste sources which was begun in the PA, a Site Investigation was completed in July 1996 by the USARTAC for the USAEC. The Site Investigation identified a total of nine AOCs by reviewing contemporary and historical aerial photographs, and available information including previous environmental studies. Following completion of the Site Investigation, USAEC determined that a phased SI was required at these AOCs. As part of the Phase I SI scope, ABB-ES performed SIs at three of these AOCs:

- AOC 3, the Resource Conservation and Recovery Act (RCRA) landfill and prominent trenches noted on historical aerial photographs

- AOC 8, a former storage area on the northwest end of the former east-west airfield runway

- AOC 9, berms, mounded materials and trenches evident in the 1951 aerial photographs

The AOCs not addressed by ABB-ES during the Phase I SI will be included in Phase II, to be conducted by the NGB, or will be investigated by the U.S. Navy as the current operator of portions of Fort Allen.

In summary, the scope of this Phase I SI has included:

1. Investigations at five of the nine potential waste source areas (OMS #9, Paint and Chemical Storage Room, Pesticide/Herbicide Mixing and Storage Area, Electrical Transformers, and the WWTP) identified in the PA,

2. Report of the progress of investigations being conducted, or proposed, at the four remaining potential waste source areas (Former Navy Landfill, Former INS Landfill, USTs, and ASTs) identified in the PA, and

3. Investigations at AOCs 3, 8, and 9, identified in the 1996 Site Investigation by the USARTAC.

The purpose of the Phase I SI at each potential waste source area or AOC was to verify the absence or presence of environmental contamination, and determine whether further investigation was warranted.

ABB-ES prepared a Technical Plan for the Phase I SI to establish the specific scope of investigation at each of the potential waste sources and AOCs. ABB-ES also prepared a Quality Assurance Project Plan (QAPjP), which sets forth the sampling and analysis, and quality assurance requirements and procedures. In addition, ABB-ES prepared an Accident Prevention and Safety Program Plan (APSPP) which established health and safety requirements and procedures for the Phase I SI. These documents were reviewed by the USAEC and finalized prior to initiation of the field program.

The SI field investigation program was conducted from November to December 1996, and laboratory analyses were completed in December 1996.

ABB-ES evaluated the chemical and physical data collected from each potential waste source and AOC during the Phase I SI. For sites at which contamination was found, ABB-ES evaluated the source, and the potential distribution and migration pathway. Preliminary recommendations regarding the need for additional investigations, if warranted, at each site were also made.

On the basis of the data and evaluations, ABB-ES has recommended that additional investigations be performed at eight of the nine potential waste source areas (identified in the PA) and all of the three AOCs (identified in the USARTAC Site Investigation Report). The findings and recommendations for the sites investigated in the Fort Allen Phase I SI are presented in Table ES-1.

1.0 INTRODUCTION

1.1 BACKGROUND

ABB Environmental Services, Inc. (ABB-ES) under contract with the U. S. Army Environmental Center (USAEC) and in accordance with Contract DACA31-94-D-0061-0010, Delivery Order No. 0010, completed a Phase I Site Inspections (SI) at Fort Allen, Juana Diaz Municipio, Puerto Rico (Figure 1-1).

A Preliminary Assessment (PA) of the Army National Guard Facility, Fort Allen, was completed in 1994 (Weston, R.F., 1994). The PA identified a total of nine potential waste source (or study) areas:

- Former Navy Landfill
- Former Immigration and Naturalization Service (INS) Landfill
- Organizational Maintenance Shop #9 (OMS #9)
- Paint and Chemical Storage Room, Building 358
- Pesticide/Herbicide Mixing and Storage Area
- Electrical Transformers
- Underground Storage Tanks (USTs)
- Aboveground Storage Tanks (ASTs)
- Wastewater Treatment Plant (WWTP)

In response to U.S. Environmental Protection Agency (USEPA) Region II's request that an SI be performed for Fort Allen, the National Guard Bureau (NGB) enlisted the aid of the USAEC to delineate the scope of the SI and to contract Phase I to ABB-ES.

To delineate the scope of the SI, the USAEC initiated several studies as outlined in paragraph 1.2.7 through 1.2.10, below. These prescoping studies were necessary due to the dense vegetation jungle environment on Fort Allen which precluded physical access to many areas of potential contamination and also due to the logistical challenges involved in conducting environmental field work outside the continental United States.

To complete the process of identifying potential study areas which was begun in the 1994 PA, and to verify the data gathered in the prescoping studies conducted by

USAEC, a Site Investigation was completed in July of 1996 by U.S. Army Terrain Analysis Center (USARTAC) for the USAEC. The objective of the Site Investigation was to characterize areas of concern (AOCs) from historical photographs and the SI pre-scoping studies, and to locate the AOCs using a global positioning system (GPS). The Site Investigation identified a total of nine AOCs by reviewing contemporary and historical aerial photographs, and available information including previous environmental studies. These AOCs combined the nine potential waste sources identified in the 1994 PA with the new areas found in the SI scoping studies to attain the most realistic grouping of contiguous or overlapping potential areas of contamination. However, the Former Navy Landfill (AOC 1) and the Former INS Landfill (AOC 2) remain, as originally identified in the PA, potential waste source areas. The following AOCs were identified as part of the Site Investigation:

- AOC 1, including the Former Navy Landfill
- AOC 2, the Former INS Landfill
- AOC 3, the Resource Conservation and Recovery Act (RCRA) landfill and prominent trenches noted on the 1962, 1963 and 1967 aerial photographs (USARTAC, 1996b);
- AOC 4, an abandoned and breached irrigation pond located in the northeast section of Fort Allen;
- AOC 5, a large crescent-shape berm, located just north of the east-west runway;
- AOC 6, a former canteen and a horse farm operated by the U.S. Navy, located in the east-central part of the installation;
- AOC 7, located in the northeast part of the installation is characterized by an irrigation pond and a series of mounds and trenches;
- AOC 8, located on the northwest part of the east-west runway, and formerly used as a storage area;

- AOC 9, located on the western edge of the east-west runway, with three groups of features evident in the 1951 photographs, including a crescent-shaped berm, mounded material and trenches.

Figure 1-2 presents the location of the potential waste source areas identified in the PA and the AOCs identified in the Site Investigation Report. The scope of this Phase I SI has included:

1) investigations at five of the nine potential waste source areas (OMS #9, Paint and Chemical Storage Room, Pesticide/Herbicide Mixing and Storage Area, Electrical Transformers, and the WWTP) identified in the PA,

2) report of the progress of investigations being conducted, or proposed, at the four remaining potential waste source areas (Former Navy Landfill, Former INS Landfill, USTs, and ASTs) identified in the PA, and

3) investigations at AOCs 3, 8, and 9, identified in the Site Investigation Report (USARTAC, 1996a).

Figure 1-3 presents the locations of the potential waste source areas and AOCs investigated during the Phase I SI. Table 1-1 presents a summary of the study areas identified in the PA and the AOCs identified in the Site Investigation Report, and the scope of responsibility for investigation. As indicated in Table 1-1, investigations at the Former Navy Landfill (included in AOC 1 in the Site Investigation Report) are proposed for a Phase II SI, due to safety concerns and the need for additional pre-investigation scoping activities. Per agreement with the U.S. Army, the Former INS Landfill (identified as AOC 2 in the Site Investigation Report) investigations are being conducted by the U.S. Navy as part of a proposed over-the-horizon radar (ROTHER) antenna installation (see Table 1-1). The USTs and ASTs at Fort Allen are under investigation by the Puerto Rico Army National Guard (PRARNG) under the direction of the Puerto Rico Environmental Quality Board (PREQB). Investigations at AOCs 5 and 6 are also being conducted by the U.S. Navy as part of the proposed ROTHER antenna installation (see Table 1-1). Investigations at AOCs 4 and 7, and a portion of AOC 1 (identified in the Site Investigation Report) are proposed for a Phase II SI.

1.2 Previous Investigations

Previous investigations conducted at Fort Allen include the following:

- Potable/Recreational Water Quality Engineering Survey No. 31-24-0482-84 (20-24 February 1984).
- PREQB RCRA Inspections (20 and 27 June 1990)
- USEPA National Pollutant Discharge Elimination System (NPDES) Compliance Report (June 1992)
- Environmental Compliance Assessment System (ECAS) Report, PRARNG (1997)
- Final PA of the Army National Guard Facility, Fort Allen (1994)
- Geophysical Investigation at Fort Allen, Puerto Rico (January 1996).
- Multi-spectral CASI Image Data over Fort Allen, Puerto Rico (February, 1996).
- Historical Photo Analysis, Fort Allen, Juana Diaz, Puerto Rico (July 1996)
- Site Investigation Report, Fort Allen, Juana Diaz, Puerto Rico (July 1996)

The following subsections summarize the purpose and conclusions of these investigations.

1.2.1 Potable/Recreational Water Quality Engineering Survey No. 31-24-0482-84

A potable/recreational water quality survey was performed by the U.S. Army Environmental Hygiene Agency (AEHA) in June 1984. The purpose of the survey was to investigate Fort Allen's potable water system, recreational waters, and swimming pools, including monitoring and laboratory support facilities, and also to investigate sources of wastewater discharge. In addition, the investigation reviewed

the wastewater collection and treatment system, evaluated the analytical documentation used for the NPDES, and reviewed the status of the Spill Prevention Control and Countermeasure Plan (SPCCP) and Installation Spill Contingency Plan (ISCP). The survey found several problems with the potable water system. These included ineffective water treatment system operation, inadequate performance of analysis to assure potable water quality, lack of an adequate cross- connection control program, and incorrect disinfection procedures following distribution system repair. To remedy these deficiencies, the survey made general recommendations for improving the potable water system. Recommendations included improving effectiveness of water treatment operations, improving the water quality monitoring program by obtaining regular bacteriological analysis, and instituting a cross-connection control program.

The survey also found specific problems with the wastewater treatment system. The lift station needed maintenance and repair and lacked backup power. The WWTP was operating without a valid NPDES permit and lacked emergency backup power, a continuous flow meter, and several safety features. Additionally, Fort Allen needed both a SPCCP and an ISCP. The survey provided specific recommendations to remedy these wastewater treatment system deficiencies. They included performing appropriate repairs and providing emergency backup power to the lift station; applying for and obtaining an NPDES permit for the WWTP; providing emergency backup power and a continuous recording flow meter for the WWTP; and upgrading safety features; and developing and implementing a SPCCP and an ISCP.

1.2.2 Puerto Rico Environmental Quality Board RCRA Inspections

Two RCRA inspections were conducted at Fort Allen in 1990 under the facility identification (ID) number PRD980527071. These inspections occurred at a time when Fort Allen was being used by the INS as a Haitian refugee processing center. The inspections were conducted by the PREQB on June 20 and June 27, 1990 (PREQB, 1990). The PREQB found that the facility had been closed, and was not operational; thus no RCRA violations were noted. According to the USEPA, no other RCRA compliance/enforcement activities have occurred at Fort Allen (Meyer 1993).

1.2.3 Preliminary Assessment Report, Fort Allen, Puerto Rico

A PA Report for Fort Allen was published in March 1991 under a USEPA ID number of PR6211843077 (NUS, 1991). It was compiled by the NUS Corporation from a Draft PA that was developed by Roy F. Weston in 1988, using site visit notes collected by Argonne National Laboratory (Weston, 1988). The PA revealed that historically there have been several potential hazardous waste sites at Fort Allen. These included several USTs, an AST, and two closed landfills. The PA reported that there were between four and seven USTs that contained diesel, gasoline, and motor vehicle gasoline (MOGAS), and that the AST had a capacity of 500 gallons and stored waste oil. According to the PA, one landfill was used by the INS prior to 1983 and reportedly contains construction debris and garbage, none of which are eligible hazardous substances under the Comprehensive Environmental Response Compensatory and Liability Act (CERCLA). The PA describes another landfill at Fort Allen that covers approximately 4 acres and was operated by the U.S. Navy from 1974 until June 1980. This landfill also reportedly contains garbage and construction debris. According to the PA, disposal records are incomplete, and the history of the site does not suggest the possibility that hazardous substances are present in the landfill. The PA describes the area surrounding Fort Allen and details potential targets (surface water, groundwater, soil, and air) in the event contaminant migration would occur. The PA ultimately recommends that no further remedial action be planned for Fort Allen as there is no evidence of the presence of CERCLA jurisdictional substances, nor any evidence of a prior release to the environment.

1.2.4 NPDES Compliance Report

A USEPA consent order USEPA-CWA-11-92-08 was issued in March 1992 to address repeated violations of Fort Allen's NPDES permit for its WWTP, which was originally issued to the U.S. Naval Communications Station in 1974 as NPDES permit No. PR0020044. The Navy's NPDES permit expired in September 1979, and PRARNG filed a transfer of ownership application for the NPDES permit in April 1984. In June 1988, the NPDES permit was reissued to the PRARNG under the same permit number. Repeated deficiencies identified during USEPA NPDES Compliance Inspections, including failure to submit Discharge Monitoring Reports, poor equipment maintenance, and substandard system design and components were typical violations historically occurring at the Fort Allen WWTP. These and other violations led to issuance of the USEPA consent order (noted above) calling for a wastewater treatment system compliance report.

In May 1992, the USEPA issued a Public Notice of Intent to deny NPDES permit application for Fort Allen's NPDES permit, based on continuing noncompliance with the NPDES permit. The PRARNG successfully responded to the public notice and retained its NPDES permit. A compliance report was subsequently prepared by the PRARNG staff in response to USEPA consent order USEPA-CWA-11-92-08. It provides the historical background of the NPDES permit for the Fort Allen WWTP and documented associated compliance issues, deficiencies, and corrective actions taken. Upon receipt and review of this compliance report, the USEPA issued consent order USEPA-CWA-II-92-156, which incorporated a compliance schedule for the unresolved consent order deficiencies associated with the wastewater treatment plant (USEPA, 1992). According to the PREQB, corrective action to the Fort Allen is ongoing, as recent permit violations continue to occur (Weston, 1994).

1.2.5 Environmental Compliance Assessment System Report, Puerto Rico Army National Guard

The ECAS is a standardized environmental compliance assessment that is being conducted by the NGB on a state by state basis. Assessments were being conducted for all National Guard facilities in Puerto Rico at the time of the PA in 1993. The ECAS report for Fort Allen is scheduled for completion in March 1997. The ECAS report may provide more specific details on transformers, storage tanks, hazardous waste storage and disposal practices, local drinking water systems, potential receptors, and other associated site information.

1.2.6 Preliminary Assessment of the Army National Guard Facility, Fort Allen

A PA was conducted at Fort Allen in 1993 by Roy F. Weston, Inc. under contract with the USAEC. The PA activities included an on-site visit, interviews with Fort Allen personnel familiar with operations, and history; acquisition and analysis of information on past hazardous materials storage and hazardous waste disposal, and acquisition and analysis of available geological, hydrogeological, meteorological, and environmental data. During the PA, nine potential waste source were identified at Fort Allen: the Former Navy Landfill (currently known as AOC 1), the former INS Landfill (currently known as AOC 2), the OMS #9, the Paint and Chemical Storage Room, the Pesticide/Herbicide Mixing and Storage Area, the Electrical Transformers, USTs, ASTs, and the WWTP. Because of the lack of analytical data, the PA recommended a phased sampling and analysis program for the Fort Allen

potable wells, groundwater upstream and downstream of the potential waste disposal areas, and sampling and analysis of surface water and sediment (Weston, 1994). In addition, the PA recommended non-intrusive subsurface investigation (ground penetrating radar and electromagnetic survey) of the identified landfills. The PA report also recommended that construction documentation dated 1940-1941 be reviewed, and potential waste disposal areas reported in this documentation be investigated.

1.2.7 Geophysical Investigation at Fort Allen, Puerto Rico

USACE Waterways Experiment Station (WES) personnel conducted a geophysical investigation for the USAEC at Fort Allen from February 22 through 26, 1995. Electromagnetic and magnetic geophysical survey methods were used to delineate the boundaries of the former INS Landfill (currently known as AOC 2) and detect buried debris southeast of the RCRA landfill (located within AOC 3).

1.2.8 Multi-spectral CASI Image Data Over Fort Allen, Puerto Rico

A multispectral imagery analysis was conducted over Fort Allen by Borstad Associates, Ltd. to identify color variations in vegetation that might be the result of soil moisture, texture, or character, or form species variations or density; factors that could be secondary indicators of landfills or unnatural disturbances caused by disposal activities. An aircraft was flown over Fort Allen to acquire multispectral aerial photography on December 11 and 12, 1995. Ground control for navigation was provided by using a GPS receiver as a base station. Geometric and geographic corrections were utilized to improve the accuracy of the first order mapped imagery produced. Using the digital data generated from the multispectral photographs several images were developed, including a simple thematic map of the main vegetation types of Fort Allen. The multispectral image data analysis identified various linear features and provide electronic base maps to be used for collecting ground truthing data with which to interpret the color variations and linear features in the image maps and air photos. Data from this investigation was used in the Site Investigation in the location of areas of concern (see Subsection 1.2.9).

1.2.9 Site Investigation Report, Fort Allen

The Site Investigation Report, completed in July 1996, by the USARTAC compiled field observations made in May 1996 of the AOCs discovered in the historical

photographic analysis. Field investigation activities included marking the locations and boundaries of the AOCs and features of concern using a GPS. A vegetation analysis, and an evaluation of the vegetation color anomalies from the multi-spectral CASI image data report (Borstad Associates, Ltd., 1996) for Fort Allen was also incorporated as part of the Site Investigation Report.

1.2.10 Historical Photo Analysis, Fort Allen

The Historical Photo Analysis Report (USARTAC, 1996b) was prepared by the USARTAC for the USAEC in July 1996. This report presents a historical aerial photograph analysis of Fort Allen from 1936 to 1995. Areas of potential environmental concern were identified by features such as trenches, mounds, depressions, and clearings or lack of vegetation that might indicate past disposal activities at Fort Allen. The analysis discovered a total of nine AOCs in the Fort Allen property.

1.3 PROJECT OBJECTIVES

The objective of the USAEC Delivery Order No. 0010, Fort Allen project is to perform a SI in accordance with all relevant state and USEPA guidance, and in compliance with USAEC-approved field methods and procedures. The purpose of the Phase I SI completed at the potential waste source areas at AOCs 3, 8, and 9, (referenced in Subsection 1.1) was to evaluate the presence or absence of any environmental impact to soil or groundwater as a result of military activities conducted in the past, and to determine whether further investigation or remediation is warranted.

1.4 PROJECT APPROACH

In order to meet the project objectives, planning documents were developed in compliance with the appropriate regulatory and USAEC guidance for site inspections through the review of pertinent data, interviews with site personnel, and information gathered during site visits.

After completion of the SI field activities at the AOCs and study areas, ABB-ES reviewed the field and laboratory data results to evaluate the presence or absence of contamination and potential pathways of contaminant migration. Review of the SI field and laboratory data for the potential waste source areas and AOCs 3, 8, 9 is documented in this Phase I SI Report. This SI report compiles all the findings, conclusions and recommendations of the SI, in addition to defining the procedures and methodology used during the SI field investigation. Human health and ecological preliminary risk evaluations (PREs) were not completed under the scope of this Phase I SI.

1.4.1 Technical Plan

The principal planning document for the Fort Allen SI was the Technical Plan, which provides detailed descriptions and discussions of the elements essential to conducting field investigation activities. The Technical Plan was prepared to address the SI field activities at Fort Allen in the Juana Diaz Municipio, Puerto Rico. The Technical Plan was prepared for the USAEC to fulfill the requirement of deliverable Data Item A004 under Delivery Order 0010 of contract DACA31-94-D-0061. The Technical Plan includes activities defined in the original Delivery Order 0010, and those discussed at an October 10, 1996 meeting between the USAEC and ABB-ES.

The Technical Plan defines responsibilities and authorities for data quality, and defines requirements for assuring that the SI activities undertaken by ABB-ES at Fort Allen were planned and completed in a manner consistent with USAEC quality assurance (QA) program objectives. The background, rationale, and specific scope for the study areas and AOCs 3, 8, 9 and investigations were set forth in the Technical Plan. In addition, this plan was developed in accordance with the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) *Guidelines for Implementation of ER 1110-1-263 for USATHAMA Projects*, May 1993, USATHAMA *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition and Reports*, March 1987, and *USEPA Guidance for Performing Site Inspections Under CERCLA, Interim Final*, USEPA/540/R-92/021, September 1992.

The background information provided in the SI Technical Plan for the AOCs 3, 8, 9 and study areas was based largely on information obtained from the Fort Allen PA (Weston, 1994), the Site Investigation (USARTAC, 1996a) and previous studies described in Section 1.2 of this report. The Technical Plan describes how the various tasks were accomplished and provides a schedule for their completion.

1.4.2 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPjP) (ABB-ES, 1996b) was prepared as a component of the Delivery Order 010 under Contract DACA31-94-D-0061. The purpose of this plan was to define responsibilities and authorities for data quality, and to prescribe requirements for assuring that the SI field investigation activities undertaken by ABB-ES at Fort Allen, were planned and executed in a manner consistent with the USAEC quality assurance program objectives. The QAPjP describes the sampling procedures, field forms, equipment calibration procedures, and field and laboratory analytical methods that ABB-ES used to complete SI work at Fort Allen.

The QAPjP provides guidance and specification to ensure that:

- samples are obtained under controlled conditions using appropriate and documented procedures;
- samples are identified uniquely, and controlled through sample tracking systems and chain-of-custody (COC) protocol;
- field determination and laboratory analytical results are of known quality and are valid, consistent, and compatible with the USAEC chemical data base through the use of approved analytical methods, preventive maintenance, calibration and analytical protocols, quality control (QC) measurements, review, correction of out-of-control situations, and audits consistent with the general requirements for QC in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, USEPA/540/g-89/004, October, 1989*;
- calculations and evaluations are accurate, appropriate, and consistent throughout the project;
- generated data are validated and their use in calculations is documented;
- safety is maintained by requiring that the health and safety staff are included in the project organization; and

- records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results.

The requirements of the QAPjP applied to all ABB-ES and subcontractor activities related to the collection of environmental measurements at Fort Allen. The QAPjP is based on guidelines contained in *Engineering and Design Chemical Data Quality Management for Hazardous Waste Remedial Activities*, U.S. Army Corps of Engineers (USACE), ER 1110-1-263, October 1990; the format, field, and data requirements in the *USAEC Guidelines for Implementation of ER-1110-1-263 for USAEC Projects*, May 1993 (USAEC, 1993); and the general requirements for QC in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, USEPA, October, 1988 for collection and analysis of samples; and the USATHAMA "Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports" (USATHAMA, 1987) for installation of borings and monitoring wells, and land survey location.

1.4.3 Accident Prevention Safety Program Plan

The Accident Prevention Safety Program Plan (APSPP) (ABB-ES, 1996c) was prepared in conjunction with the Fort Allen Technical Plan, and in accordance with the same schedule and review requirements. The APSPP, prepared in compliance with ABB-ES' Health and Safety Program, was intended to meet the requirements of Occupational Safety and Health Administration (OSHA) regulations 29 Code of Federal Regulations (CFR) 1910.120. The APSPP ensures that health and safety procedures are maintained by requiring inclusion of the health and safety staff function in the project organization.

1.4.4 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative or quantitative statements developed by the data user to specify the quality of data needed from a particular activity to support specific decisions. The DQOs are the starting point in the design of the investigation. The DQO development process matches sampling and analytical capabilities to the data targeted for specific uses, and ensures that the quality of the data does not underestimate project requirements. The USEPA has identified five general levels of analytical data quality as being potentially applicable to field investigations conducted at potential hazardous waste sites under CERCLA (USEPA, 1987). These levels are summarized as follows:

- Level I - Field Screening: This level is characterized by the use of portable instruments which can provide real time data to assist in the optimization of selecting a sampling point for health and safety support; data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sample locations.

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- Level II - Field analysis: this level is characterized by the use of portable analytical instruments that can be used on site or in mobile laboratories stationed near a site (close-support laboratories); depending upon the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

- Level III - Laboratory analysis using methods other than the Contract Laboratory Program (CLP) routine analytical services (RAS): This level is used primarily in support of engineering studies using standard USEPA-approved procedures; some procedures may be equivalent to CLP RAS, without the CLP requirements for documentation.

- Level IV - CLP RAS: This level is characterized by rigorous QA/QC protocols and documentation, which provide qualitative and quantitative analytical data.

- Level V - Non-standard methods: This level includes analyses that may require method modification and/or development; CLP special analytical services (SAS) are considered Level V.

DQOs were developed for the Fort Allen project to provide that data collected during the field investigation be of sufficient quality to evaluate the presence of absence of contamination. For the Fort Allen SI, field measurements such as pH, temperature, specific conductance, and readings from a HNu photoionization detector (PID) and MSA Model 260 O_2/Explosimeter constituted Level I field screening data.

Soil vapor surveys conducted during the SI provide qualitative data to assess the presence or absence of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in soil. Analytical data collected from the survey is considered Level I data.

Analytical data from on-site immunoassay analyses is considered Level II. Soil samples from GeoProbe® investigations were analyzed using immunoassay test kits to provide semi-quantitative data to support interpretation of the presence or absence of contaminants.

In addition to the on-site immunoassay screening, GeoProbe® samples were collected, packed on ice and shipped to Quanterra Environmental Services, Inc., of Arvada, Colorado to generate Level II data to evaluate the presence or absence of contamination in subsurface soils. Geoprobe® soil samples were submitted to Quanterra Environmental Service, Inc. for analysis of VOCs, and oil and grease.

Analyses for organics and inorganics where specific USAEC certified methods were used, is considered Level III data. Analysis of soils for gasoline and diesel hydrocarbons was conducted. The hydrocarbon analyses provide quantitative data meeting Level III data quality.

USAEC requirements and analytical processes used during the SI are discussed in Section 3.0 of this report. They focus on the use of off-site laboratory control spikes in associated data lots to measure the performance of the laboratory in the use of USAEC methods. Many of the USAEC methods are identical to standard USEPA methods. The certification process, required by off-site laboratories performing USAEC work, is discussed in Subsection 3.2.3.1. The data review and evaluation process are described in Subsection 3.2.3.1.

Off-site laboratory data were evaluated for precision, accuracy, representativeness, completeness and comparability (PARCC) in order to meet USEPA Level III requirements. This was accomplished through the collection of field quality control blanks such as trip blanks and equipment rinsates and through the evaluation of off-site laboratory blanks such as method blanks. The specific purpose of collecting each of these is discussed in Subsection 3.2.3 of this report. Off-site laboratory control spikes are run in the certification process to generate control charts that help to establish control limits that are used to ensure accuracy of the results. This process is described in the text of the report in Subsection 3.2.3.1.

The precision of the data is a measurement of the ability to reproduce a value under certain conditions. It is a quantitative measurement based on the differences of two values. Due to the fact that matrix spike/matrix spike duplicate samples and field duplicate samples were not required to be collected by the USAEC QA program, evaluations of the precision of the data were not completed for the Fort Allen Phase I SI.

Accuracy measurements identify the performance of a measurement system based on tests with known values. The off-site laboratory, sampling, and media effects on accuracy were assessed by reviewing the percent recoveries of spiked analytes for off-site laboratory control samples and surrogate compounds.

Representativeness refers to the extent to which a measurement accurately and precisely represents a given population within the accepted variation of off-site laboratory and sampling measurements. Collection techniques that obtained samples characteristic of the matrix and location being evaluated were chosen. Historic information was used to identify sample locations. Representativeness was also evaluated using method blanks and field quality control sample data. By evaluating method blank and field quality control samples false positive results should be identified.

Completeness refers to the percentage of useable, valid values obtained through data evaluation. Completeness was determined by the success rate in meeting holding time criteria and acceptance of sample lots by USAEC.

Comparability is a qualitative assessment describing the confidence with which one data set may be compared with another. Comparability was assured using standard operating procedures for sampling, and by reporting analytical results in standard units.

1.5 Project Organization and Responsibilities

Because of its importance to the success of project tasks, the following discussion focuses primarily on the QA/QC organization and responsibilities for the Fort Allen project. Emphasis is directed toward the chemical analysis program where accuracy and reliability were critical. Specific QA and QC responsibilities for the implementation of the Fort Allen QAPjP have been assigned to QA technical

management personnel in the USAEC, ABB-ES and the subcontractor laboratory. Each member of the ABB-ES technical project team is responsible for performing the work in accordance with the approved QAPjP and for providing the required documentation. Management personnel provide the overall QC documentation, control, and assessment/corrective action. QA and QC personnel provide oversight and review of data quality. Figure 1-4 illustrates the personnel functional relationships (i.e., lines of authority/responsibility and communication) for QC and QA in the Fort Allen SI. The QA/QC duties of each position are identified in the following subsections.

1.5.1 USAEC Commander

Ultimate responsibility for all activities conducted in support of USAEC projects rests with the Commander of USAEC and is delegated to an USAEC Contracting Officer's Representative (COR) and the Chemistry Branch.

1.5.2 USAEC Contracting Officer's Representative

During the AOCs 3, 8, 9 and the study areas SI effort, the duties of the USAEC COR have included acting as the principal contact between USAEC, ABB-ES, PRARNG, and Fort Allen; requiring effective implementation of the USAEC QA Program; providing ABB-ES' QAPjP to the Chemistry Branch for review and approval; forwarding Chemistry Branch review comments to ABB-ES; and providing formal notification to the Contracting Officer of unapproved deviations from the QA Program. Other responsibilities have included informing the Chemistry Branch of difficulties and problems encountered by ABB-ES in implementing the QA Program; discussing proposed changes in approved sampling and analysis procedures with the Chemistry Branch; and providing any ABB-ES/Subcontractor Laboratory certification documentation to the Chemistry Branch for review and approval.

1.5.3 USAEC Chemistry Branch, Technical Support Division

The duties of the USAEC Chemistry Branch, Technical Support Division have included advising the Commander on QA/QC practices; recommending to the Commander QA practices to be used to support USAEC projects; reviewing and approving project plans; providing standardized analytical methods, as necessary; and providing analytical reference materials to the laboratory. Additional responsibilities have included supplying Target Reporting Limits to the USAEC COR based on the

formal list of applicable analytes; reviewing and recommending approval of any proposed modifications to analytical methodology; recommending certification of laboratory analytical methods as necessary prior to collecting field samples; providing guidance to the USAEC COR on implementation of QA/QC by the laboratory; providing guidance to the USAEC COR on chemistry matters; and evaluating the quality of data generated by the laboratory. Other QA/QC Chemistry Branch responsibilities have included monitoring the effective implementation of QA/QC and reporting questionable practices to the Commander of USAEC; and coordinating data reporting requirements with the USAEC Data Management Group.

1.5.4 ABB-ES Program Manager

The ABB-ES Program Manager is responsible for the overall USAEC program at ABB-ES. During the AOCs 3, 8, 9 and study areas SI efforts, specific responsibilities have included overall technical responsibility for the program; establishing and overseeing all subcontracts for support services; initiating program activities; and participating in the work plan preparation and staff assignments. Additional duties have included identifying and fulfilling equipment and other resource requirements; monitoring task activities to ensure compliance with established budgets, schedules, and the scope of work; regularly interacting with the USAEC and NGB regarding the status of the project; coordinating and reviewing monthly performance and cost reports (PCRs); and ensuring that appropriate financial record and reporting requirements were met.

Within the overall technical responsibility for the program, the Program Manager has supported the ABB-ES QA Supervisor in the development of the Fort Allen QAPjP and the enforcement of its requirements in the implementation of the project. The Program Manager has reviewed and resolved conflicts relative to corrective action.

1.5.5 ABB-ES QA Supervisor

The ABB-ES QA Supervisor has responsibility for establishing, overseeing, and auditing specific procedures for documenting and controlling analytical and field data quality. Many of the procedures are implemented by other individuals but the QA Supervisor must ensure that procedures are being implemented properly and the results interpreted correctly.

The QA Supervisor has documented every inspection and ensured that procedures for analysis of each type of matrix (e.g., groundwater, surface water, soil, and sediment), as described in the QAPjP, are followed. The QA Supervisor has the authority to require resampling at any area where sample integrity was determined to have been affected by faulty sampling procedures, after obtaining concurrence with USAEC personnel.

Specific QA and QC tasks for the implementation of the Fort Allen QAPjP have been assigned to quality assurance and management personnel in ABB-ES and the laboratory. Each member of the ABB-ES technical project team has been responsible for performing work in accordance with the approved Fort Allen QAPjP and for providing required documentation. Management personnel have provided the overall QC documentation, control, and assessment/corrective action. QA and QC personnel have provided oversight and review of data quality.

For the AOCs 3, 8, 9 and study areas SI efforts, project-specific responsibility for QA/QC within ABB-ES has occurred under the supervision of the ABB-ES Project QA Supervisor. The ABB-ES QA Supervisor has authority independent of the Fort Allen Project Manager and Program Manager to issue corrective actions up to and including cessation of work performed out of compliance with the approved Fort Allen QAPjP. The ABB-ES QA Supervisor has responsibility for establishing, overseeing, and auditing specific procedures for documenting and controlling analytical and field data quality.

1.5.6 ABB-ES Project Manager

The ABB-ES Project Manager is responsible for effective day-to-day management of all operations. The Project Manager has responsibilities which specifically include preparing work plans, including approval of monitoring locations, chemical analysis parameters, schedules, and labor allocations; managing all funds for labor and materials procurement; monitoring and controlling the schedule; managing the site team toward unified, productive project accomplishment; preparing PCRs; communicating directly with the USAEC COR; and reviewing all task deliverables and providing technical leadership. Within this framework, the Project Manager has supported the ABB-ES QA Supervisor in the development and implementation of the QA Program, and provided resources for review, audit, and corrective action.

1.5.7 Laboratory Program Manager

The laboratory analytical program for the SI was conducted by Quanterra Environmental Services, Inc. of Arvada, Colorado; a USAEC-approved laboratory.

The Laboratory Program Manager has provided direction to the analysts at Quanterra and has been responsible for implementing the USAEC QA Program. Major Laboratory Program Manager responsibilities have included supporting the efforts of the Quanterra Laboratory Quality Assurance Coordinator (QAC) to ensure that the USAEC QA Program was being properly implemented; providing sufficient work space, instrumentation, resources, and personnel to conduct all analyses according to the USAEC QA Program requirements; ensuring that all purchased chemicals (i.e., standards, solvent, and reagents) were checked for proper identity and adequate purity; and ensuring the implementation of any corrective actions which were deemed necessary to mitigate QA/QC deficiencies.

1.5.8 Laboratory QA Coordinator

In the fulfillment of QC requirements, the Laboratory QAC has provided the ABB-ES QA Supervisor with all QC data for review and intermittent status reports.

The ABB-ES QA Supervisor and Project Manager have delegated implementation of analytical QC functions as appropriate to the Quanterra Laboratory QAC. Major activities in the continued implementation of the USAEC QA Program at Quanterra include monitoring the QA/QC activities of the laboratory to ensure conformance with the established protocols and good laboratory practices, as appropriate; informing the Laboratory Program Manager, individual analysts, and Quanterra corporate management, as appropriate, of nonconformance to the QA Program and recommending corrective actions to reestablish conformance with the requirements of the QA Program; and requesting the appropriate Standard Analytical Reference Materials from USAEC upon receipt of delivery orders.

The QAC has also been responsible for ensuring that all documents pertaining to the Fort Allen effort (i.e., records, logs, standard procedures, project plans and analytical results) are maintained in a retrievable fashion and distributed to the appropriate personnel; establishing, with the analysts, the proper analytical lot size for daily analysis and correct daily QC samples to be included in each lot according to the established procedures for evaluating acceptable, in-control analytical performance

(i.e., initial and daily calibration and appropriate control charts); and establishing, with the designated sample custodian, that samples received in the laboratory are logged in properly, and are the appropriate analytical lot size. In addition, it has been the QAC's responsibility to verify that sample numbers for the QC samples were allocated in the correct manner.

Other duties have included ensuring that analysts were preparing the proper QC samples, maintaining control charts, and implementing any recommended corrective actions; ensuring that instrument logs and QC documents were being maintained with all the required information documented; collecting control charts from the analysts, discussing the results with the analysts and Laboratory Program Manager, and submitting these control charts to ABB-ES on a regular basis; reviewing all laboratory data prior to the reporting of data to other project participants; and maintaining an awareness of the entire laboratory operation for adherence to the procedures specified in the USAEC QA Program.

1.5.9 Project Review Committee

A key component of ABB-ES' corporate QC policy is the designation of a Project Review Committee (PRC) for each project or task. The members of the PRC were assigned according to the technical functions to be conducted. During the AOCs 3, 8, 9 and study areas SI efforts, the function of this group of senior technical and/or management personnel has been to provide guidance on the technical aspects of the project. This has been accomplished through periodic reviews of the services provided to ensure they (1) reflected the accumulated experience of the firm, (2) were being produced in accordance with corporate policy, and, most importantly, (3) met the objectives of the program as established by ABB-ES and USAEC.

2.0 INSTALLATION BACKGROUND AND PHYSICAL SETTING

Fort Allen is located on the southern coast of Puerto Rico, approximately 10 miles east of the city of Poncé, and 1 mile north of the Caribbean Sea (Figure 1-1). The nearest community, Juana Diaz, is located approximately 4 miles from the northern boundary of Fort Allen. The Fort Allen property consists of approximately 941 acres (approximately 1 mile wide by 1.5 miles long) and lies entirely in the Juana Diaz Municipio (county) (Gousha, 1988). Fort Allen is bounded on the east by State Road No. 149, and the Jacaguas River runs along a portion of the northern facility boundary (Gousha, 1988). The approximate geographic coordinates of Fort Allen are 18° 00'54" N latitude and 66° 30'26" W longitude (Weston, 1994).

Fort Allen is federally owned, and is operated as a PRARNG training facility. The primary function of Fort Allen is to provide weekend and annual training facilities for various National Guard units and individuals who are based throughout Puerto Rico. Fort Allen is used only for classroom training because the PRARNG conducts all of its field training and major vehicle and equipment maintenance at Camp Santiago, which is located about 30 miles to the east (Weston, 1993). Fort Allen activities occur in the main cantonment area (see Figure 1-2), and other areas of Fort Allen are leased or operated by other parties. Approximately 22 acres of Fort Allen contains the Fort Allen U.S. Army Reserve Center. About 40 acres are leased by the Commonwealth of Puerto Rico for the operation of a minimum security prison, and a U.S. Naval Communications Station maintains and operates communications transmitters on approximately 75 acres (Heath, 1993). The areas not under PRARNG operational control, such as the U.S. Army Reserves Center, are not within the scope of this investigation.

2.1 HISTORY

Fort Allen was originally built in 1940 and 1941 for the U. S. Army Air Corps. At that time it was called Losey Field, but has had several other names throughout its operational history including Poncé Air Base, Poncé Airfield, Losey Airfield, Fort Allen Naval Radio Station, and Fort Allen National Guard Training Facility. Losey Field was built for the U.S. Army Air Corps in 1940 and 1941 and operated as an airbase until approximately 1944. Ownership of Losey Field was transferred to the U.S. Navy in about 1944. No information regarding the operational activities at

Losey Field is available, however, locations of the Losey Field facilities are shown on a 1940-1941 plot plan (Weston, 1994). After 1944, the U.S. Navy used Fort Allen as a Naval Radio Communications Station. From approximately 1979 to 1983, Fort Allen was used by the U.S. INS as a processing center for Haitian Refugees. In March 1982, the ownership of Fort Allen was transferred back to the USACE. Fort Allen began operating as a training site for PRARNG units in 1983.

The PA conducted in 1993 revealed that Fort Allen had no consent decrees executed, enforcement action taken, or compliance notices issued pursuant to the RCRA. Records show that the PREQB conducted two RCRA inspections at the Fort Allen Processing Center (Building 225) under ID No. PRD980527071 in 1990 (see Subsection 1.2.2). The PREQB found that the facility had been closed and no violations were noted. Fort Allen is listed as a small quantity RCRA generator under ID No. PR6211843077 (Weston, 1993). According to USEPA Region II Caribbean Office, Fort Allen has no spills or releases recorded in the Emergency Response Notification System (ERNS) database.

2.2 Physical Setting

The climate, vegetation, ecology, physiography, soils, surficial and bedrock geology, and regional hydrogeology of Fort Allen are described in the following sections.

2.2.1 Climate

The climate in the Fort Allen area is characterized by warm, even temperatures with little seasonal variation. The mean annual temperature at Fort Allen is 83°F (AEHA, 1984). In the winter, low temperatures average about 65°F, with highs around 87°F. In the summer months, the temperatures range from lows around 80°F to highs near 100°F (AEHA, 1984). Fort Allen is located in a dry region of the island of Puerto Rico. The Cordillera Central mountain range (located in the center of the island) captures the moisture from the prevailing northeast winds. As a result, the south side of the island is much drier. The annual rainfall for the Fort Allen area averages 40 inches. Precipitation in the area is not evenly distributed throughout the year. The dry season encompasses the months of January, February and March, with the months of June and July being relatively hot and dry months. The wet season is divided into two parts: April and May mark the first part, while

August through October is the rainiest season. During the dry season, there are no flowing streams in the vicinity of Fort Allen (AEHA, 1984).

2.2.2 Vegetation

Fort Allen falls within the semideciduous forest zone of the southern coast of Puerto Rico (USARTAC, 1996a). The southern coastal plain's physiographic zone is considered to be the semiarid region of the island (USARTAC, 1996a). The historical patterns of land use, slight differences in soil type, and artificial canal structures have created three generalized floral communities within the boundaries of Fort Allen (USARTAC, 1996a). The first of these floral communities is in the cantonment area. This community is dominated by maintained commercial grasses and scattered landscape planting of decorative native and nonnative trees and shrubs. This area is bounded by the east-west runway complex to the north and by the post fence to the south, east and west. The second floral community covers much of the northern half of Forth Allen, except for the northeast and northwest corners. This flat, dry area is dominated by stands of tall (1 to 2.5 meter) Guinea Grass (Panicum maximum) (USARTAC, 1996a). Several species of trees adapted to this dry environment are scattered throughout this grassland in a widely spaced and regular distribution. The dominant species is Zarcilla (Leucaena glauca), with Bayahonda (Prosopis juliflora) and Palo de Rayo (Parkinsonia aculeata) also being abundant. The third floral community is in the northeast and northwest corners of the property and along a wide belt zone running east-west, just north of the east-west runway. This is a tropical forest community that is densely vegetated and rich in species diversity. The dominant woody species of these three areas include Moca (Andira inermis), Guama americano (Pithcellobium dulce), Guacima jacocalalu (Guazuma ulmifolia), Jaboncillo (Sapindus saponaria), Acacia amarilla (Albizia lebbek), Guacimilla (Trema micrantha), and Burro Prieto (Capparis cynophalophora) (USARTAC, 1996a). These areas also support epiphytes and a variety of vines. Dominant among the vines species is Jessamine (Jasmine sp.). Prior to the development of Fort Allen; the area was cultivated with sugarcane; an irrigation system consisting of canals and aqueducts diverted surface water for irrigation. These canal and aqueduct features remain on the grassland areas.

2.2.3 Ecology

Fort Allen encompasses mostly terrestrial habitats, although a small area near the Jacaguas River in the northwest part of the property consists of wetlands

(USARTAC, 1996a). Floral and faunal diversity is strengthened by the installation's close proximity to the Jacaguas River. Much of Fort Allen was formerly agricultural land. Existing habitat types reflect the site history, ranging from abandoned agricultural land to secondary growth forested regions. Fort Allen is generally reverting back to a natural state, composed of forest and grassland.

2.2.4 Physiography

Fort Allen is within the southern coastal lowland geographic region of Puerto Rico (Bogart, et. al., 1964). All of the landforms are products of erosion and deposition of the Cordillera Central mountain range, which is the line of highest mountains running east-west, and dividing the island of Puerto Rico into a northern two-thirds and a southern one-third (Bogart et. al., 1964). The Cordillera forms the principal drainage divide and most of the larger rivers of Puerto Rico originate in these mountains. The Cordillera is composed mostly of hard volcanic and metamorphic rocks.

The southern coastal lowland, on which the Fort Allen property is located, is covered by sand, silt and clay. Limestone is found in patches in many places. The river valleys are generally wide, and, in places, sand and silt in the valleys form wet flats. The Jacaguas River meanders south from the town of Juana Diaz passing by the northern and western borders of the Fort Allen property towards the Caribbean Sea. The Canas River is located to the east of Fort Allen, and further east the Descalabrado River meanders south to the Caribbean Sea.

The topography of Fort Allen is generally flat with a gentle slope running from north to south. The topographic elevation ranges from approximately 79 feet (24 meters) in the northwest part of the property to 9.8 feet (3 meters) along the southwest property line.

2.2.5 Soils

Fort Allen lies within the Juana Diaz Municipio (county) in Puerto Rico (see Figure 1-1). The soils of the Juana Diaz Municipio have been mapped by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS) (SCS, 1979). The mapped area is within the Sur (South) Soil Conservation District.

Soil mapping units ("soil series") at Fort Allen are somewhat poorly drained and are gently sloping within the coastal plain. The soils are derived from fine-textured sediments of volcanic and limestone origin. Permeability is low, and the available water capacity is high; runoff is low, (USARTAC, 1996a). Soils in Fort Allen area generally consist of four associations, Constancia, Fraternidad, Fe', and Yauco (Gierbolini et al., 1979). The general distributions of the soil series are shown in Figure 2-1, and descriptions of the soil series are provided below.

> Ct - Constancia. Poorly drained, calcareous, nearly level soils on flood plains in semiarid area. Slopes 0 to 2 percent. These soils formed in recent fine-texture sediments of mixed origin that washed from volcanic and limestone hills. Constancia soil have low permeability and have a high content of organic matter.
>
> FtB - Fraternidad Series. Moderate well drained, gently sloping to strong sloping soils on the coastal plains in semiarid area. Slopes are 2 to 12 percent. The origin of these soils is volcanic and limestone rock. Permeability is low, and the available water capacity is high.
>
> Fe - Fe' Series. Somewhat poorly drained calcareous, saline, nearly level soils on alluvium fans slightly above flood plains in the semiarid area. Slopes 0 to 2 percent. These soils formed in fine textured sediment that was derived from volcanic and limestone rock. Permeability is low, and the available water capacity is high; runoff is low. The salt content of these soils is high.
>
> Yauco Series. Well drained, calcareous, gently sloping and strongly sloping soils on rounded hills and foot slopes below the limestone hills in the semiarid area. Slopes range from 2 to 12 percent. These soils formed from transported moderate fine textured sediment derived from limestone. Permeability is moderate, and the available water capacity is low to moderate. Natural fertility is high, and the organic matter in the sublayers is high.

Fraternidad soils are widespread and form a large part of the soils at Fort Allen. Fe' series soils are limited to the southeast corner of the property, and Constancia soils are concentrated on the southwest part of the property to the west of the cantonment area. Yauco soils are concentrated in the northeast part of the property, south of the Jacaguas River (see Figure 2-1).

2.2.6 Geology

Fort Allen is located in the South Coast hydrogeologic province of Puerto Rico (Gomez-Gomez, 1987) in the southern karst belt (Troester et al., 1987). The South Coast Province consist primarily of alluvial and terrace deposits, forming a continuous coastal plain from Patillas to Poncé, and of alluvial stream valleys cut into Tertiary limestone from Poncé to Guanica (Gomez-Gomez, 1987). Fort Allen is located between the Patillas and Poncé areas. This area consists of a series of coalescing alluvial fans formed by fast flowing intermittent streams, and is characterized by hilly uplands and low-lying river valleys that slope southward toward the Caribbean Sea.

The coastal plain sediments below a topographic elevation of 100 (30.5 meters) to 150 feet (45.7 meters) are of Holocene (presented day to 10,000 years ago) age. Above 150 feet mean sea level (msl) the coastal sediments are of Holocene to Pleistocene (present day to 2 million years ago) age (Gomez-Gomez, 1987). The unconsolidated deposits are thin near the mountains, but thicken towards the south (Bogart et. al., 1964). These alluvial deposits contain a higher proportion of sand and gravel at the apex of the major fans and become finer-grained towards the coast (Gomez-Gomez, 1987). These deposits consist of sand, silt, clay, and gravel in floodplain and terrace deposits, and piedmont fan deposits (Briggs and Akers, 1965). Colluvium is found along the margins of the alluvial deposits. The thickness of the unconsolidated material varies locally, but generally increases seaward (Gomez-Gomez, 1987). West of Salinas to Poncé, the alluvium ranges in thickness from 180 to about 300 feet near the shoreline (Gomez-Gomez, 1987). At Santa Isabel an oil-test reported unconsolidated deposits thickness of 3000 feet (Clover, 1977). The unconsolidated deposit contain extensive amounts of coarse permeable sand and gravel which are the principal water-bearing materials in the area.

Below the unconsolidated deposits, the bedrock geology west of Salinas consists of sedimentary rocks of Tertiary age (Gomez-Gomez, 1987). The Tertiary sedimentary rocks from youngest to oldest are the Poncé Limestone and the Juana Diaz Formation. The Poncé Limestone is recrystallized, relatively pure, reef limestone that is very resistant to erosion (Gomez-Gomez, 1987). The Poncé Limestone is divided into a lower and an upper member, both members are fossiliferous and of middle Tertiary (approximately 25 million years ago) age (late Oligocene to early Miocene) (Grossman et al., 1972). The maximum thickness of this formation is 2,950 feet. The upper member of the Poncé Limestone is a hard, thick-bedded and finely

crystalline limestone and calcarenite that locally contains shale beds. The maximum thickness of the upper member is 1,310 feet. The surface of Poncé Limestone is extensively modified by solutioning, with solution openings and cavities forming a mature karst topography (Grossman et al., 1972). Deeper sections are less affected by solutioning (Heath, 1984). The Poncé Limestone commonly strikes east-west and dips to the south at an angle of about 10 degrees (Grossman et al., 1972).

Underlying the Poncé Limestone is the Juana Diaz Formation. Not as uniform as the Poncé Limestone, the Juana Diaz Formation consists of a sequence of clastic rocks: predominantly sandy limestone, some conglomerate and shale of early and middle Oligocene age (Grossman et al., 1972).

The Juana Diaz Formation unconformably overlies the late Cretaceous and early Tertiary (approximately 70 million years ago) volcanic rocks (Troester et al., 1987). Thickness of the Juana Diaz Formation ranges from 0 feet in the highlands to the north to 2,150 feet along the coast (Briggs and Akers, 1965). Although the unit is coarse-grained, it is also poorly-sorted and relatively impermeable (Grossman, et al., 1972). The Juana Diaz Formation is unimportant as a source of water since it is highly mineralized, however, this formation can yield small supplies of water for livestock use (Grossman, et al., 1972).

The Cretaceous-Tertiary volcanic and intrusive rocks are well-jointed and dip southward more steeply than the overlying rocks (Grossman et al., 1972). The volcanic rocks consist primarily of pyroclastic rocks, volcanic flows and sills, and some sedimentary rocks (Heath, 1984). During the early Tertiary, these volcanic, intrusive, and sedimentary units were compressed, folded, and metamorphosed, resulting in hard, dense rocks (Heath, 1984). A northwest-southeast trending fault is located within this Cretaceous-Tertiary unit just north of Juana Diaz. It exhibits left-lateral strike-slip movement and normal dip-slip movement and generates low-magnitude earthquakes (Briggs and Akers, 1965). These volcanic rocks are locally deeply weathered.

The geologic formations present in the vicinity of Fort Allen are summarized in the following table.

GEOLOGIC FORMATIONS PRESENT IN THE VICINITY OF FORT ALLEN

GEOLOGIC FORMATIONS	DEPTH FROM SURFACE	THICKNESS (feet)
Pleistocene-Holocene Unconsolidated	0 feet	variable, up to 1,968
Poncé Limestone	~400 feet (120 meters)	maximum ~4,300
Juana Diaz Formation	~4,700 feet (1430 meters)	maximum ~2,100
Cretaceous-Tertiary Volcanics	~6,800 feet (2070 meters)	---

2.2.7 Hydrogeology

Hydrostratigraphic units in the vicinity of Fort Allen include (Grossman et al., 1972):

- Cretaceous-Tertiary volcanic and intrusive rocks
- Oligocene Juana Diaz Formation
- Oligocene-Miocene Poncé Limestone
- Pleistocene and Holocene unconsolidated materials

The Cretaceous-Tertiary volcanic and intrusive rocks are hard, dense rocks with openings only in interconnected faults and fractures (Heath, 1984). Estimated hydraulic conductivity ranges from 10^{-5} to 10^{-8} feet/day (ft/day) (10^{-8} to 10^{-11} centimeters per second [cm/sec]) (Freeze and Cherry, 1979). Well yields are small to moderate, generally less than 250 gallons per minute (gpm) (Briggs and Akers, 1965). The unit is not considered to be hydrologically important due to predominantly low well yields and the high concentration of dissolved solids in the water (Gomez-Gomez, 1987).

The Oligocene Juana Diaz Formation, which consists of shale, sandy limestone, and sandy conglomerate, is also considered to be hydrologically unimportant (Grossman et al., 1972). Thickness of the unit ranges from negligible to absent in the highlands to the north, to 2,150 feet along the coast (Briggs and Akers, 1965). Estimated hydraulic conductivities range from 10^{-7} ft/day (10^{-10} cm/sec) for the shales to approximately 10^{-2} ft/day (10^{-5} cm/sec) for sandy conglomerate (Freeze and Cherry,

1979). Wells yields from this formation are small (less than 50 gpm). The water contains high chloride and sulfate although fresh water is found locally.

The Oligocene-Miocene Poncé Limestone is extensively modified by solutioning, with openings and cavities forming a mature karst topography (Grossman et al., 1972). Deeper sections are less affected by solutioning (Heath, 1984). The upper part of the limestone, which has a known maximum thickness of 1,310 feet, has a higher hydraulic conductivity due to extensive modification of the rock by solutioning (Roman-Mas and Ramos-Gines, 1987). Brahana et al. (1988) estimated the hydraulic parameters for karstified limestones as follows:

PARAMETER	AVERAGE	RANGE
Porosity (%)	10	5 to 50
Hydraulic Conductivity (ft/day) [gal/day/ft^2]	3.28×10^5 [1.16×10^2]	3.28×10^{-1} to 3.28×10^7 [1.16×10^{-4} to 1.16×10^4]
Well Yield (gpm)	1.56	15,800

The Poncé Limestone is dry in most areas, and the water probably contains salt near the sea (Briggs and Akers, 1965). Well yields are small to moderate (less than 50 gpm to 250 gpm); the best yields are found near sea level and in river valleys (Briggs and Akers, 1965).

The primary aquifer in the Fort Allen area is the Pleistocene and Holocene alluvial and colluvial deposits (Heath, 1984; Grossman et al., 1972). Thickness of the unit is variable, but thicknesses up to 1,968 feet have been observed in fluvial valleys (Gomez-Gomez, 1987). Well yields are also variable, depending on unit thickness and grain size (Briggs and Akers, 1965). Large quantities of water and large well yields (greater than 250 gpm) are found in alluvial fans and on the southern coastal plains, where deposits are thickest and recharge occurs readily from surface water sources. Wells in gravel beds yield as much as 4,000 gpm (Briggs and Akers, 1965).

At Fort Allen, the alluvium and limestone are hydraulically connected and together form a single hydrostratigraphic unit (Heath, 1984). Hydraulic conductivity for the unconsolidated alluvial/colluvial deposits ranges from 2.8×10^4 ft/day (9.9 cm/sec) for well-sorted gravel to 2.8×10^{-4} ft/day (9.9×10^{-8} cm/sec) for silty sand (Freeze and

Cherry, 1979). Grossman et al. (1972) determined the average specific capacity for sand and gravel in the Tallaboa Valley, located west of Fort Allen, to be 40 gallons per minute per foot (gpm/ft) (1 to 179 gpm/ft range); for the sand, gravel, and limestone to be 65 gpm/ft (2.5 to > 100 gpm/ft range); and for limestone only to be 3 gpm/ft (0. 1 to 6 gpm/ft range). The March 1986 water table elevation at Fort Allen ranged from 10 feet mean sea level (MSL) in the southeastern corner of the site to approximately 40 feet MSL in the northern portion of the site (Roman-Mas and Ramos-Gines, 1987), with flow to the southeast. Recharge to the aquifer is from precipitation and from the surface water sources including regulated streamflow. Discharge from groundwater is to streams, coastal wetlands, and offshore springs and seeps (Heath, 1984). There is also groundwater withdrawal at wells and evapotranspiration within the nearshore zone, where the water table is near the land surface (Gomez-Gomez, 1987).

In summary, the primary aquifer at Fort Allen is the surficial alluvial aquifer, with a variable thickness of approximately 400 to 1,968 feet and a hydraulic conductivity between 10^{-4} to 10^{4} ft/day (10^{-8} to 1 cm/sec). A secondary source of groundwater in the area of the site is the Poncé Limestone at approximately 400 foot depth with an estimated thickness of 4,300 feet and a hydraulic conductivity dependent on the degree of karst development. Karst and solution cavities are well developed in the upper approximately 1,300 feet of the unit, resulting in an estimated hydraulic conductivity of 10^{5} ft/day (10^{1} cm/sec). The lower section of the aquifer does not have well developed karst and the estimated hydraulic conductivity is 10^{-3} ft/day (10^{-7} cm/sec), the lowest hydraulic conductivity at the site. The values presented in this section for Fort Allen are estimates from published literature, as no well logs from the site were available to determine total thicknesses and depths of the aquifers.

Figure 2-2 presents a potentiometric surface map of the alluvial aquifer in the Fort Allen area, obtained from the Fort Allen SI Report (USARTAC, 1996a). Water levels were obtained from irrigation and domestic-supply wells. The potentiometric surface elevations range from 30 feet (9.1 meters) msl in the northern portion of Fort Allen, to 10 feet (3.3 meters) msl in the southeastern corner of the property. Inferred groundwater flow direction is to the south-southeast, toward the Caribbean Sea.

Groundwater in the aquifers beneath Fort Allen have been assigned to Class SG1 by the PREQB. By definition, Class SG1 groundwaters include those which serve,

or have the potential to serve, as sources of drinking water supply and agricultural uses, including irrigation.

3.0 SITE INSPECTION PROGRAM SUMMARY

The activities of the Fort Allen SI discussed in the following subsection were the first environmental sampling activities conducted in the potential waste source areas and AOCs at Fort Allen. As such, site-specific conditions and health and safety concerns were the predominant factors in the development of the field program. The number, type and location of samples may differ slightly from those presented in the Technical Plan (ABB-ES, 1996a) due to site conditions encountered in the field.

The SI field programs for the potential waste source areas and AOCs 3, 8, 9 consisted of:

- surface soil sampling;
- soil borings and subsurface soil sampling
- installation of monitoring wells;
- completion of GeoProbe® subsurface soil sampling;
- soil vapor surveys;
- well development;
- groundwater sampling;
- immunoassay field analysis of soil samples;
- off-site laboratory analysis of environmental samples;
- horizontal survey of exploration locations;
- elevation survey of monitoring wells; and
- one round of water-level measurements.

ABB-ES established a project field office in Building 334 (F) of the cantonment area in Fort Allen. The field office was used for equipment storage and maintenance, sample management, shipping and receiving, staff meetings, and communications. A radio base-station and cellular telephone were maintained in the field office; each field crew was issued a hand-held radio. ABB-ES and subcontractor staff were briefed about the nature of the AOCs and study areas, health and safety requirements, Fort Allen traffic regulations, and key technical requirements.

ABB-ES initiated the SI field program for the study areas and AOCs 3, 8, 9 in November, 1996 with sampling of the source water well, a site reconnaissance, and preliminary GPS survey. GeoProbe® sampling, monitoring well drilling, and field

sampling were completed during a two week period beginning on November 11, 1996. One round of groundwater sampling was completed the week of December 2, 1996.

Buried utilities were identified from discussions with the maintenance supervisor and Fort Allen personnel, as no buried utilities records were available. The subcontractors retained by ABB-ES in conducting the SI program were as follows:

- Soil Tech Corp., San Juan, PR - Drilling and monitoring well installation.
- Terra Vac Inc., San Juan, PR - GeoProbe® soil sampling and soil vapor probe installation
- Quanterra Environmental Services, Inc., Arvada, CO - Chemical analysis of environmental samples. Quanterra is also referred to in this report as the "off-site analytical laboratory".
- W. L. Gore, Elkton, MD - Chemical analysis of soil vapor probes.
- Benigno Rodriguez Burgos and Asociados, Poncé, PR - Elevation surveying of monitoring wells.

The following subsections described the activities completed during the SI at Fort Allen.

3.1 Field Investigation Procedures

The following sections provide summaries of the procedures used by ABB-ES and its subcontractors in completing the investigations and related activities. The results of these investigations are summarized in Sections 4.0 through 15.0.

3.1.1 Surface Soil Sampling

Soil grab samples were collected during the Phase I SI at locations of visible or suspected surface soil contamination. Surface soil samples were collected using a stainless steel hand-operated 3.25 inside diameter (ID) bucket auger by advancing the auger to a depth ranging from 0 to 0.5 feet bgs. Care was taken not to collect vegetative material. Samples were placed in a stainless steel mixing bowl and mixed

with a stainless steel spoon to break-down soil clumps. A soil sample was removed from the bowl using the spoon and placed in pre-labeled sample jars. The sample jars were stored on ice at 4° celsius (C) in coolers. Surface soil sampling was completed in accordance with the requirements of the Fort Allen Technical Plan (ABB-ES, 1996a), and the QAPjP (ABB-ES, 1996b.) Surface soil sample identification numbers were recorded on a chain-of-custody. Collected samples were packed on ice and shipped to Quanterra Environmental Services, Inc. in Arvada, Colorado to be analyzed.

3.1.2 GeoProbe® Subsurface Soil Sampling

A truck-mounted GeoProbe® System was used during the SI to collect soil samples for chemical analysis. GeoProbe® sampling was completed in accordance with the requirements of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b).

A 4-foot long, 1-inch-diameter steel probe was pushed (hydraulically) and hammered (with a vibratory hammer) into the ground which allowed the collection of subsurface soil samples from discrete depths. The steel probe was lined with a new disposable teflon liner for each sample. Where conditions permitted, the soil samples were collected from depths of 0 to 4 feet, 4 to 6 feet, and 6 to 10 feet bgs. The samples were screened with a PID, and one sample from each location was submitted for analysis based on results of PID screening and visual observations. GeoProbe® data records are included in Appendix A.

Subsurface soil samples were also analyzed on-site by immunoassay analyses and/or were recorded in a chain-of-custody, packed on ice and shipped to Quanterra Environmental Services, Inc. in Arvada, Colorado for USEPA Level II analyses.

3.1.3 Soil Borings

Soil borings were drilled during the SI at Fort Allen to determine the nature of the subsurface geologic materials, to collect subsurface soil samples for chemical analysis, and in some cases, to install monitoring wells. Soil boring advancement and subsurface soil sampling was completed in accordance with the requirements of the Fort Allen's Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b).

A total of 8 soil borings were drilled at the AOCs and study areas to characterize subsurface soil conditions and collect soil samples. The locations at each AOC and study area were determined based on site-specific conditions encountered during the field program.

Soil borings were advanced to a depth of ten feet bgs. Subsurface soil samples were collected from a 2-foot long, 3-inch ID split-spoon sampler through 3.25-inch ID hollow-stem augers (HSAs). Samples were collected at 5-foot intervals (0-2 feet, 5-7 feet, and 10-12 feet bgs). Each sample was screened with a PID, and one sample was submitted for off-site laboratory analysis of semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, gasoline-range organics (GRO), and diesel-range organics (DRO). Analyses were performed by Quanterra Environmental Services, Inc. using USAEC performance-demonstrated methods. Appendix B contains the soil boring logs for the SI.

3.1.4 Soil Vapor Survey

Soil vapor surveys were completed at selected study areas and AOCs as part of the SI field program to evaluate the presence or absence of contaminants in the vadose zone. Soil vapor screening samples were collected using passive sorbent collection devices, described in Subsection 4.4.4 of the QAPjP (ABB-ES, 1996b). A total of 20 soil vapor collection devices were installed and 19 were recovered; one of the soil vapor collection devices was lost in the Pesticide/Herbicide Mixing and Storage Area as a result of Fort Allen personnel activity in the area (see Section 8.0). The soil vapor probes were analyzed for VOCs and SVOCs by gas chromatograph/mass spectrometer (GC/MS). Appendix C contains the soil vapor survey report.

3.1.5 Groundwater Monitoring Wells

A total of four groundwater monitoring wells were installed as part of the Fort Allen SI to determine the groundwater flow direction and the presence or absence of contamination downgradient of potential waste sources. Groundwater monitoring wells were installed at: AOC 3 (2 monitoring wells), AOC 8 (1 monitoring well) and AOC 9 (1 monitoring well). Monitoring well installation was completed in accordance with the requirements of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b).

Borings were made with 6.25-inch ID hollow-stem augers, and soil samples were collected at 5-foot intervals with a 3-inch outside diameter (OD) split-spoon sampler to characterize the subsurface geology. Soil samples collected were screened in the field using a PID, and stored in soil reference jars. The monitoring wells were constructed using a 15-foot long, 2-inch ID, schedule 40, polyvinyl chloride (PVC) well screen with 0.010-inch slots. A 15-foot long well screen was used to account for (unknown) seasonal fluctuations in the elevation of the water table. Well riser material consists of 2-inch ID schedule 40 PVC. Well screens for the four monitoring wells were vertically positioned to straddle the water table. The annular space between the borehole and the well screen was backfilled up to 5 feet above the top of the well screen with No. 2 W.G. Morie sand. Following sand pack installation, a 5-foot bentonite pellet seal was installed and hydrated, and the rest of the borehole backfilled to ground surface using cement grout. The monitoring wells were completed at the surface using a 6-inch ID steel protective casing, four 4-inch ID protective steel posts, and a concrete surface pad.

Monitoring well completion diagrams are provided in Appendix D.

3.1.6 Well Development

Newly installed wells were developed with a PVC hand pump to remove foreign substances potentially introduced during drilling, to increase efficiency of the wells, and to reduce the turbidity of the groundwater. Development was initiated a minimum of 48 hours following monitoring well completion. The pump was decontaminated with source water from the source well prior to development of each well. For wells that were slow to recharge (i.e., MW-03-02), development was accomplished using a stainless steel bailer. Well development was completed in accordance with the requirements of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b).

Field parameters were measured during development to determine when sufficient well development had been completed. Measured parameters included pH, temperature, specific conductivity, and turbidity. In the case of MW-03-02, which was extremely slow in recharging, the required number of five well volumes could not be obtained within the timeframe of the field program.

Appendix E contains the well development records for the Fort Allen SI monitoring wells.

3.1.7 Groundwater Sampling

No sooner than two weeks after completion of well development, groundwater samples were collected from the monitoring wells completed during the SI. Groundwater sampling was completed in accordance with the requirements of the Fort Allen's Technical Plan (ABB-ES, 1996a).

One round of groundwater samples was collected from new monitoring wells. Groundwater sampling procedures are presented in the Fort Allen QAPjP (ABB-ES, 1996b). The groundwater samples were submitted to Quanterra Environmental Services, Inc. for analysis of VOCs, SVOCs, TAL inorganics, GRO, and DRO by USAEC performance-demonstrated methods. Field measurements for pH, temperature, specific conductivity, and turbidity were collected from each well during purging. Water level measurements were made in each monitoring well prior to purging.

Appendix F contains the groundwater sampling data records for the Fort Allen SI.

3.1.8 Water Level Measurements

Water-level measurements were made in the four monitoring wells to evaluate groundwater flow patterns. Measurements in wells were made from surveyor marks (typically on the north side at the top of the PVC risers), using electronic water-level meters. Water levels were measured to the nearest 0.01 foot. Table 3-1 presents the water level data and computed elevations for each of the four monitoring wells installed during the SI. Figure 3-1 presents the water table contour plan created from the water level data.

Tests to evaluate aquifer hydraulic conductivity were not performed on any monitoring well installed during the SI.

3.1.9 Surface Water and Sediment Sampling

No surface water or surface sediment samples were collected during the Phase I SI field program, as no surface water bodies were identified at the areas investigated at Fort Allen.

3.1.10 Elevation and Location Survey

The elevation and location surveys were completed in accordance with the requirements of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). Elevations of the four monitoring wells were surveyed by a local surveyor, and referenced to the Puerto Rico, 1940 adjustment, vertical datum. Elevations of the ground surface, top of monitoring well protective casings and top of PVC well risers were measured to the nearest 0.01 foot (0.003) meters.

Horizontal locations were surveyed with a Trimble GPS unit with a radio beacon. The GPS unit was used to map site features and determine horizontal coordinates (to the nearest 3 feet) of exploration locations. Explorations surveyed by the GPS included site features, soil borings, monitoring wells, GeoProbe® explorations, surface soil sample, and soil vapor sampling probe locations.

Appendix G contains the vertical elevation and GPS horizontal location survey data for the Fort Allen SI.

3.1.11 Decontamination

Field equipment was decontaminated with USAEC-approved source water from the Fort Allen Water Well #2 (WW#2). WW#2 is located in the center of the Fort Allen Cantonment area, southeast of OMS #9. Decontamination of the field equipment was completed in accordance with the requirements of the Fort Allen QAPjP (ABB-ES, 1996b).

Drilling equipment was decontaminated before arriving at exploration locations, using high-pressure hot water. Miscellaneous tools, samplers, and monitoring probes were brushed off and rinsed with USAEC-approved source water and then were thoroughly scrubbed, triple-rinsed with USAEC-approved source water, and air-dried. Decontamination fluids were not containerized.

After being filled and sealed, sample containers were wiped and cleaned as necessary in the field to prevent contamination of the sample handling/shipping area.

3.1.12 Investigation-Derived Waste

Investigation-derived waste (IDW) was generated in association with personal protection, drilling, well construction, well development, and sampling. The IDW was handled in accordance with the requirements of the Fort Allen's Technical Plan (ABB-ES, 1996a) and the QAPjP (ABB-ES, 1996b). Drill cuttings were drummed in 55-gallon drums as they were generated at each boring and monitoring well location. Well development and purge water was also containerized. Drums containing IDW were clearly marked with the contents, location identification and date of containerization. These drums were left on wooden pallets inside the concrete, fenced area at AOC 8.

3.2 Analytical Program

The analytical program for the Fort Allen Phase I SI activities was designed to identify the presence or absence of a variety of chemical contaminants that may be present based on available information about historic operations at Fort Allen. The analytical program included on-site analyses designed to generate data which meet USEPA Level II data quality goals, and analysis of samples at an off-site laboratory designed to generate data which meet USEPA Level II and Level III data quality goals (USEPA, 1987). A detailed description of analytical data quality objectives is summarized in Subsection 1.4.4 of this SI Report, and presented in Section 3.0 of the Fort Allen Final QAPjP (ABB-ES, 1996b). A soil vapor study was also conducted to provide USEPA Level I results for the screening of locations for the presence and absence of VOCs and fuel-related hydrocarbons. Descriptions of the soil vapor analyses, the on-site analytical program, and the off-site analytical program are presented in the following subsections. A summary of data quality evaluations and data usability considerations are also presented for each subsection.

3.2.1 Soil Vapor Analytical Program

Soil vapor data for chlorinated and fuel related hydrocarbons were generated using thermal desorption followed by GC/MS analyses. A description of analytical procedures and target analytes is contained in Appendix C.

Target analyte results and interpretations of the soil vapor study are presented on a site-specific basis in Sections 6.0 through 8.0, 12.0, and 14.0. During review of the

reported results, a number of target analytes were detected in the method blanks and trip blanks, indicating low concentration contamination of samples may have occurred during laboratory analysis and/or shipping. Sample results were corrected by subtracting the highest concentration reported in any of the associated blanks from the original sample result. Both original and corrected results are presented in Appendix C.

3.2.2 Field Laboratory Analyses

Soil samples were analyzed on-site using immunoassay test kits to determine the presence or absence of fuels, pesticides and polychlorinated biphenyls (PCBs).

The immunoassay methods followed draft USEPA methods outlined below:

- Method 4020 for PCBs (0.5 parts per million [ppm] detection limit)
- Method 4030 for petroleum hydrocarbons (2.5 ppm BTEX and 40 ppm total petroleum hydrocarbons [TPH] detection limits
- Method 4041 for DDT (0.2 ppm detection limit)
- Method 4042 for chlordane (.020 ppm detection limit)

The immunoassay kits were selected to provide confirmation of positive detection of the listed target analytes at the approximate limits of detection outlined above. The immunoassay tests were also selected because they yield positive responses to similar compounds or classes of compounds (USEPA, 1995). For example, the PCB immunoassay may react with a positive detection if high concentrations of other halogenated organic compounds or fuels are present at the sample location. The chlordane kit will exhibit a positive response to parts per billion (ppb) concentrations of other organochlorine pesticides including endrin, endosulfan, dieldrin, heptachlor, and lindane, and high concentrations of gasoline, PCBs, trinitrotoluene, and pentachlorophenol. The kits have been selected to cover a wide range of fuel, organochlorine pesticide, and SVOCs that may be present at the site. The data from the immunoassays were used qualitatively for the investigations. Confirmation of the identification of contamination has been recommended at sites where detections were observed. The analysis was conducted in accordance with the manufacturer's specifications included as Appendix I.

The immunoassay kits for the SI were selected from the following manufacturers:

- EnviroGard DDT and Chlordane kits developed by ENSYS, Inc., Morrisville, NC. Phone: 919 941-5509

- DTECH Environmental Detection Systems for BTEX/TPH and PCBs developed by EM Science/Strategic Diagnostics Incorporated, Gibbstown, NJ. Phone: 800 222-0342

A summary of specifications and performance of each kit provided by the manufacturer is included as Appendix I.

For the BTEX/TPH, PCB, and chlordane analyses, acceptable QC measurements outlined in the manufacturer instructions were obtained indicating results were useable without qualification.

During the DDT analyses two sets of analyses were conducted due to QC measurements that did not meet method specifications. Raw results from the analyses are outlined on Table 3-2. During the original batch 1 analyses, the negative control sample did not meet specifications of the method. Non-linear response was also observed in the 3 point calibration (0.2 parts per million (ppm), 1.0 ppm, and 10 ppm). In accordance with the manufacturers instructions, the entire set of three samples were reanalyzed. In the batch 2 reanalysis, acceptable negative control results were obtained, however, one of the three standards (1.0 ppm) did not show a linear response. The negative control and standard anomalies indicate the tendency for false positive response in the data sets. In the sample data, samples PPH0104X (Site ID GP-PH-01) and PPH0204X (Site ID GP-PH-02) had results that indicate a positive response for DDT. A negative result was obtained for sample PPH0304X (Site ID GP-PH-03). The sample results were consistent between the two batch analyses adding support to the interpretation of presence of DDT in PPH0104X (Site ID GP-PH-01) and PPH0204X (Site ID GP-PH-02), and absence of DDT in PPH0304X (Site ID GP-PH-03). However, the results do contain a high degree of uncertainty and should be considered tentative until further confirmation by additional sampling and analysis.

3.2.3 Off-site Analytical Program

The off-site laboratory analytical program was conducted in accordance with the USAEC Guidelines for Implementation of ER 110-1-263 for USAEC Projects (USAEC, 1993). The USAEC QA includes requirements for the approval of

laboratory methodologies, the determination of applicable reporting limits (Method Detection Levels [MDLs]) for parameters evaluated using each analytical method, and QC sample analytical requirements for each method. A detailed description of the USAEC analytical program is contained in the USAEC QA Program (USAEC, 1993) and Subsection 7.3.1.

In addition to the USAEC procedures described above, standard USEPA methods were used for a subset of off-site analytical samples (from all GeoProbe® borings). These methods are not supported by USAEC method validation. The additional off-site samples were collected to provide Level III and Level II data quality. A detailed description of the USEPA methods, data deliverable requirements, and data review procedures are provided in Subsection 3.2.3.2.

Based on a review of the Fort Allen operational history and previous investigations, samples were analyzed for parameters listed in the Final Technical Plan development for each investigation. Off-site analytical methods for soil and water matrices tested for USEPA CLP Target Compound List (TCL) VOCs, TCL SVOCs, TAL Inorganics, TPH modified for DRO and GRO, and Oil and Grease.

Listings of target analytes and reporting limits for the USAEC methods and the Level II and III USEPA methods are provided in Appendix H.

3.2.3.1 Laboratory and USAEC Method Certification. Analyses were performed by Quanterra Environmental Services, Inc. of Arvada, Colorado. Quanterra is a USAEC-certified subcontract laboratory. The primary methods used to generate quantitative data were certified under the USAEC QA Plan (USAEC, 1993). USAEC currently manages and reviews data generated from methods certified by USAEC. Certified methods were used for the analysis of TCL VOCs, TCL SVOCs, and TAL Inorganics. A number of QA processes were established to ensure that the analytical data generated at the off-site laboratory are adequate for the objectives of the SI. A laboratory Quality Assurance Plan (QAP) is in place at Quanterra which provides QA procedures for the laboratory. A copy of the QAP is provided in Appendix B of the Fort Allen Final QAPjP (ABB-ES, 1996b). Standard operating procedures (SOPs) have been written for the USAEC and standard USEPA methods employed during the SI. The SOPs provided documentation of the analytical processes and QC requirements for each analytical method that the laboratory followed. Copies of Quanterra method SOPs are contained in Appendix C of the QAPjP (ABB-ES, 1996b).

Additional quality assurance procedures for the off-site program are outlined in the USAEC Guidelines for Implementation of ER 1110-1-263 for USAEC Projects (USAEC, 1993). The guideline outlines sample collection specifications, laboratory validation procedures, a description of USAEC method validation, instrument calibration requirements, QC sample analytical requirements, and data review and reporting requirements for USAEC methods.

A combination of laboratory method performance demonstration and validation, method documentation, and long term review of method accuracy is used in the USAEC analytical program. Before using an analytical method to analyze environmental samples, a Contactor Laboratory must demonstrate the ability to perform the method for specific analytes, and, in the process, generate data to be used in establishing MDLs. Standardized analytical methods are selected from the USEPA's CLP, SW-846, or from some other USEPA standard method (i.e., 200, 500, and 600 series). Laboratory validation involves the determination of MDLs, and the documentation of methods to the USAEC.

During method validation, the laboratory determines a MDL for all analytes of interest. MDLs are determined as follows:

- The laboratory prepares a standard matrix sample at 1 to 5 times the estimated MDL (based on the USAEC required detection level (RDL) and the instrumental detection limit);
- 7 aliquots of the sample shall be processed through the entire method;
- The standard deviation shall be calculated from the results of the seven aliquots;
- The MDL is equal to the standard deviation times the Student's t value (3.143) for the number of measurements.

MDL results are used to determine method reporting limits, Upper Reporting Levels (URLs), and calibration standard levels, and a copy of the calibration curve used for the MDL determination. The URL is the highest value which the laboratory can report and to which the method is calibrated. All detected concentrations above the URL are diluted to within the reporting range.

When samples are shipped to the laboratory, the samples are organized into lots. Lot assignments are made for each individual methodology. The lot size is defined as the number of samples, including QC samples, that can be extracted, analyzed, or digested in a single day as controlled by the rate limiting step in the method.

USAEC divides analytical methods into 4 classes for determining the number and types of QC samples per lot, and for use in automated data validation routines. The USAEC method classes are as follows:

- CLASS 1 Methods - These are methods for the analysis of organic parameters, with the exception of GC/MS methods and pesticides/PCBs by GC, and for the analysis of inorganic parameters.

- CLASS 1M Methods - These are GC/MS methods, both for the analysis of volatiles and semivolatiles.

- CLASS 1P Methods - This class is restricted to methods for the analysis of pesticides and PCBs by GC.

- CLASS 2 Methods - This class is reserved for screening type methods, which give only a qualitative (i.e., yes/no) result.

A summary of USAEC validated methods is presented in Table 3-3. The USAEC Methods utilized for this program are summarized below:

- USAEC Class 1M methods for TCL VOCs and SVOCs. These methods are based on USEPA Methods 8240 and 8270, respectively (USEPA, 1986).

- USAEC Class 1 method for TAL inorganics. Inorganics methods are based on USEPA Methods 6010 (ICP), 6020 (ICP/MS), graphite furnace atomic absorption (GFAA) methods for lead (7421), selenium (7740), and thallium (7841), and mercury Methods 7470 and 7471 for aqueous and solid matrices.

QC samples are introduced into the train of environmental samples to function as monitors on the performance of the analytical method. All required QC samples are prepared from standard matrices (clean soil or water) or actual field samples, as

required, and processed through the complete analytical method. Stock solutions used to spike QC samples are prepared independently of stocks used for calibration standards.

The following types of QC samples are included in each analytical lot:

Class 1 Methods:

- Method Blank, to verify that the laboratory is not a source of sample contamination;
- Spikes of all control analytes (required analytes spiked into QC samples) in standard matrices, to verify performance;
- Spikes of surrogates in all field samples, to observe recovery effects in the environmental matrix (if possible for the method).

The number and concentration of QC samples analyzed per lot for the USAEC Methods are summarized below:

CLASS 1

1 - Standard Matrix Method Blank
3 - Standard Matrix Spikes
    2 x MDL, 80% URL, 80% URL (approx.)
All Field Samples - Natural Matrix Spikes
    80% URL (approx.) Surrogates Only (if possible for the method)

CLASS 1P

1 - Standard Matrix Method Blank
4 - Standard Matrix Spikes
    2 x MDL, 2 x MDL, 80% URL, 80% URL (approx.)
All Field Samples - Natural Matrix Spikes
    80% URL (approx.) Surrogates Only

CLASS 1M

2 - Standard Matrix Method Blank/Spikes
    80% URL (approx.) Surrogates
All Field Samples - Natural Matrix Spikes
    80% URL (approx.) Surrogates Only

CLASS 2

1 - Standard Matrix Method Blank
1 - Standard Matrix Spike
    1 x MDL

Class 1P Methods:

- Method Blank, to verify that the laboratory is not a source of sample contamination;

- Spikes of all control analytes (required analytes spiked into QC samples) in standard matrices, to verify performance;

- Spikes of surrogates in all field samples, to observe recovery effects in the environmental matrix.

Class 1M Method (GC/MS Only):

- Method Blanks/Spikes, to verify that the laboratory is not a source of sample contamination (non-surrogates) and to verify performance (surrogates);

- Spikes of all control analytes (surrogates only) in every field sample, to observe recovery effects in the environmental matrix.

Each day of analysis, the analyst will analyze and quantify each analyte in the method blank and spiked QC samples. QC sample results are plotted on control charts for each analytical method. Statistical upper and lower control limits for the recovery and difference of duplicate spike results are established and updated on an ongoing basis for each parameter.

For Class 1, Class 1P, and Class 1M methods, control charts are used to monitor the variations in the precision and accuracy of routine analyses and detect trends in these variations. The construction of a control chart requires initial data to establish the mean and range of measurements. The QC control charts are constructed from data representing performance of the complete analytical method. Control charts consist of tabulated data and graphical portrayals of the information described below. Software packages to be used to construct charts is provided by USAEC to Quanterra, and the use of the USAEC supplied software is required.

Data from spiked QC samples within a lot are compared to control chart limits to demonstrate that analyses of the lot are under control and will be used to update the charts. X-R control charts are used in the USAEC guidelines.

Each control chart includes the following information:

- Analyte;
- Method number;
- Laboratory;
- Spike concentration;
- Matrix; and
- Chart title - select one of the following:

  1) Single Day X-Bar Control Chart - High Spike Concentration
  2) Single Day X-Bar Control Chart - Low Spike Concentration
  3) Single Day Range Control Chart - High Spike Concentration
  4) Single Day Range Control Chart - Low Spike Concentration
  5) Three-Day X-Bar Control Chart - Low Spike Concentration
  6) Three-Day Range Control Chart - Low Spike Concentration

- Four letter lot designation for each point, shown on the x-axis;
- Percent recovery (for X control charts) or Range (for R control charts) along the y-axis;

- Upper control limit (UCL), on X and R control charts;
- Upper warning limit (UWL), on X and R control charts.
- Mean, on X and R control charts;
- Lower warning limit (LWL), on X control charts; and
- Lower control limit (LCL), on X control charts.

For some analytes specified by USAEC, warning limits on X charts will be deleted and replaced by modified control limits based on data quality specifications.

If the method is judged to be out-of-control and reanalysis occurs, no point from the initial analysis may be used to update charts.

Specifics on the construction of control charts, and requirements for method control evaluations, can be found in Appendix H of the USAEC guidance (USAEC, 1993).

The laboratory submits quality control reports as specified in the USAEC QA Program (USAEC, 1993). The USAEC Chemistry and Geology Branch will review data to insure that the subcontract laboratory is performing analyses in compliance with USAEC criteria. Based on laboratory secondary review, and QC reviews conducted by USAEC, samples results with QC non-compliance are qualified. Qualifiers are added by the subcontract laboratory as flagging codes and/or by USAEC as data qualifiers. A summary of flagging code and data qualifiers used in the USAEC QA Program are presented in Appendix K. Interpretations on the usability of results and the interpreted significance of qualification of data are addressed in the site-specific contaminant assessments presented in Section 4.0 through 15.0 of this Phase I SI Report.

3.2.3.2 USEPA Analytical Methods. Samples were submitted to Quanterra for off-site analysis by USEPA methods to generate Level III GC flame ionization detector (FID) analysis for GRO and DRO, and to provide additional Level II screening data for the Fort Allen Phase I SI. USEPA analytical methods are outlined on Table 3-3 for VOCs, GRO, DRO, and oil and grease.

The USEPA Level III analyses were conducted using modified USEPA Method 8015A. A purge and trap analysis was conducted to evaluate gasoline. Target compounds include BTEX and total GRO. DRO analyses were conducted using a methylene chloride sonication extraction followed by a direct injection and analysis. Detailed procedures for the modified USEPA Method 8015A analyses are contained in Appendix C of the QAPjP (ABB-ES, 1996). Results from these analyses were entered into the USAEC Installation Restoration Data Management Information System (IRDMIS) data base as an un-certified methodology.

The USEPA Level II methods were not reported or evaluated using the USAEC QA program. Quanterra performed analyses in accordance with the referenced analytical methods. Deliverable packages consisted of a results summary equivalent to the USEPA CLP Form 1 report, a method blank summary outlining results of method blank analyses and the associated field samples, summary tables of initial and continuing calibration data, surrogate recovery results, and summaries of laboratory control sample results analyzed with each analytical batch.

The results of the Level II analyses were reviewed by the project chemist to evaluate data quality and usability of results. The project chemist reviewed initial and continuing calibration data, laboratory control sample recoveries, method blank results, surrogate recoveries, holding times and sample data summary reporting forms. No data quality deficiencies were identified and sample results were 100% useable for Level B data quality objectives outlined for the Fort Allen Phase I SI.

3.2.3.3 Data Review and Reporting. All off-site laboratory numerical results are reported in terms of concentration in the environmental sample. Correction factors (e.g., percent soil moisture and dilution factor) have been applied to data to generate a final result.

USAEC Methods and IRDMIS

Data from the USAEC methods and USEPA Level III analyses were entered into the IRDMIS in a format consistent with all IRDMIS requirements. Details relative to specific data requirements and entry procedures are provided in the IRDMIS Users Guide and Data Dictionary (USAEC, 1995), the IRDMIS Personal Computer (PC) Data Entry and Validation Subsystem Guide (USAEC, 1994), and the USAEC Geotechnical Requirements (USATHAMA, 1987).

All chemical and geotechnical data files were submitted via modem to the USAEC Bulletin Board System at Aberdeen Proving Ground, MD, managed by Potomac Research Institute (PRI). All geotechnical data (i.e., groundwater stabilized [GGS] and field drilling [GFD] files) were submitted directly to PRI after the file passed IRDMIS PC Data Entry and Validation QC checks.

The following files were produced during the Fort Allen SI:

- GMA (map files): for monitoring wells and soils
- GFD (field drilling files): describing lithology and boring and monitoring well installation
- GWC: describing monitoring well construction details
- GGS: groundwater stabilized field for water level measurements taken prior to sampling
- CGW: chemical analysis, groundwater
- CSO: chemical analysis, soils

Data reduction, conducted by the laboratory, is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective. Samples received at the laboratory were divided into sample lots according to method, matrix, and analytical QC groups.

All data were reviewed by the laboratory in accordance with USAEC requirements. Laboratory data validation involves a thorough review of all data documentation. Data are considered complete only after they are approved by the contract laboratory QA staff prior to transmittal. The reviews are done on every batch to ensure that all QC checks required by the method are included in the batch.

Upon electronic transmission of chemical data to ABB-ES by the contract laboratory, ABB-ES executed the IRDMIS PC Data Entry and Validation Subsystem on all chemical lots received. These "group and record" checks are designed to detect any remaining deficiencies in the data. These may include site identifications not previously existing in the IRDMIS database, or a variety of quality control problems

such as unacceptable spike and surrogate recoveries not previously detected by the contract laboratory. Upon completion of all lots in a particular task, the laboratory provided a copy of the USAEC Level 2 data for review. These data are only to be used for preliminary review and are not equivalent to the final data entered into IRDMIS, (i.e., Level 3 data). Acceptable data lots were transmitted via modem to PRI at Aberdeen Proving Grounds, MD.

Final acceptance of electronic data was performed by USAEC through IRDMIS PC software and the USAEC QC sample reviews. All flagging codes recommended by the laboratory were checked and approved. Data qualifiers may be added by the USAEC Project Chemist into IRDMIS upon completion of validation. Data qualifiers may be added to results if quality control requirements for control samples are not met, spike recoveries do not fall within acceptance limits, holding times are exceeded, surrogate recoveries are out of acceptance limits, or some other factor is identified that affects the quality of reported results. A listing of laboratory flagging codes and USAEC data qualifiers with applicable definitions is provided in Appendix K.

All data present in IRDMIS are considered useable with the exception of data qualified with an "R". No data from the Fort Allen Phase I SI were qualified with an "R". Data packages are generated at the off-site laboratory for each lot of samples for each USAEC analytical method.

A data package contains all the data necessary to support the results of one analytical method for one lot of samples. Data packages are freestanding with all documentation of laboratory analyses without reference to other documents or files. The data packages are currently on file at ABB-ES. A data package is basically all back-up data for a CLP data package, without the CLP report forms.

Records contained in the data package include, but are not limited to the following:

- Original chromatograms, strip charts, or other instrument output.
- Original chain of custody form and carrier transmittal documents.
- All hardcopy GC/MS output.
- Expanded scale blow-up of manually integrated peak(s).

- All data sheets or other preprinted forms used by the contractor laboratory.

- All injection logs.

- For inorganics by ICP, one sample per lot shall have the ICP spectra printed in hard copy, if possible, according to the instrument used.

- Copies of all relevant notebook pages. This includes preparation of calibration and QC spiking standards (from stocks to working standards), calibration, sample appearance, sample pH, sample preparation/extraction, moisture determinations, calculations, and any other relevant comments.

- Corrective action and non-conformance reports.

- Hard copy of the transfer file as transmitted to USAEC.

USEPA Analytical Method Reporting

A discussion of data reporting requirements for samples submitted for USEPA method analysis was presented in Subsection 3.2.3.2. Reduced deliverable packages have been defined for the off-site laboratory Level II analyses with project chemist review of holding times, method blanks, instrument calibration performance, laboratory control sample analysis, and surrogate recoveries. Results of the off-site Level II analyses were not transmitted to the USAEC IRDMIS. Results of the Level II analyses were entered into a spreadsheet, and summary tables of results were generated for inclusion into the Phase I SI report.

Level III data generated using USEPA Method 8015A for TPH modified to quantify gasoline and diesel were transferred to IRDMIS as a non-certified analytical method. Full data packages were generated by the off-site laboratory. Data packages were validated by the ABB-ES project chemist based on action presented for organics analyses in USEPA guidelines (USEPA, 1994). The USEPA guidelines are not specifically written for the 8015A method, and the chemist used professional judgement when reviewing the laboratory data packages. A summary of data validation review and actions is presented in Appendix K.

3.2.3.4 Field Quality Control Samples. During the Phase I SI field program, field QC sample including field blanks, equipment rinse blanks, and trip blanks were collected. No field duplicate or matrix spike samples were collected during sampling. Although matrix spike samples were not designated in the field at the time of sample collection, matrix spike samples were selected and analyzed for GRO and DRO at the off-site laboratory. A summary of the QC sample results is presented in Appendix K.

SI data sets were evaluated for possible off-site laboratory or sampling-related contamination. This evaluation did not include validation by USEPA guidelines. Sample results reported and discussed in this SI Report were not adjusted for reported analytes that were also detected at similar concentrations in blanks associated with that sample; action levels were not established, and the 5- and 10-times rule was not applied to compounds detected in associated blanks. Common laboratory contaminants include the VOCs acetone, methylene chloride, toluene and SVOC phthalate esters (e.g., bis(2-ethylhexyl)phthalate). No positive detections were removed from the data as they would be in the USEPA validation process.

General trends relating to blank and sample contamination were examined. Comparison of blank data with results from the entire data set are discussed as a data assessment. Assessments are made based on analyte detection in blanks, the frequency of this detection and the concentrations of these analytes. Interpretation on the significance of blank contamination on individual sample results are made on a site-specific basis in Sections 6.0 through 15.0 of this report. A brief summary of QC blank results is present below.

Method Blanks

Method blanks were analyzed at the laboratory with the samples to evaluate if sample processing and analysis resulted in contamination of samples. All method blank data from the 1996 Fort Allen Phase I SI are presented in Appendix K.

Inorganic. All of the aqueous inorganic method blank results were non-detect, which indicated that there was no inorganic element laboratory contamination in aqueous samples.

Inorganic elements were detected in soil method blanks. The frequency and concentrations of many of the inorganic elements are likely due to background levels inherent in the USAEC-approved soil media. These results are not interpreted to be indicative of introduced laboratory contamination.

VOCs. All of the aqueous VOC method blank results were non-detect for target compounds. This indicated that there was no VOC target compound laboratory contamination in aqueous samples. One unknown VOC was reported at the reporting limit 1 micrograms per liter [μg/L]) in the aqueous VOC method blank associated with lot VAFW. The presence of this tentatively identified compound (TIC) may indicate laboratory contamination in samples belonging to lot VAFW, but it is not interpreted as having a significant impact on the aqueous sample data.

Soil samples were not analyzed for VOCs.

SVOCs. All of the aqueous SVOC method blank results were non-detect. This indicated that there was no SVOC laboratory contamination in aqueous samples.

All of the soil SVOC method blank results were non-detect for target compounds. This indicated that there was no SVOC target compound laboratory contamination in soil samples. Seventeen unknown SVOCs were detected in the SVOC soil method blank associated with lot BSBS. The unknown SVOC concentrations ranged from 0.07 microgram per gram (μg/g) to a maximum of 7 μg/g. The prèsence of these unknowns may indicate introduced laboratory contamination in samples belonging to lot BSBS. All surface and subsurface soil samples collected for analysis of SVOCs by USAEC methods were grouped in lot BSBS.

TPH - GRO. Soil and aqueous method blanks were analyzed for total petroleum hydrocarbons associated with gasoline (TPH-GRO) using USEPA method 8015A. All of the soil and aqueous TPH-GRO method blank results were non-detect. This indicated that there was no TPH-GRO laboratory contamination in soil and aqueous samples.

TPH - DRO. Soil and aqueous method blanks were analyzed for total petroleum hydrocarbons associated with diesel fuel (TPH-DRO) using USEPA method 8015A. All of the soil and aqueous TPH-DRO method blank results were non-detect. This indicated that there was no TPH-DRO laboratory contamination in soil and aqueous samples.

Rinse Blanks

Inorganics. All of the results for rinse blanks associated with aqueous inorganic sampling were non-detect. This indicated that there was no inorganic element contamination as a result of aqueous sampling techniques.

The rinse blank RNSW-SB-02, associated with soil boring sampling at sites SB-08-01, SB-08-02, SB-PH-01, and SB-M9-01 contained concentrations of several inorganic elements including aluminum, chromium, iron, and manganese. These results are not interpreted to indicate contamination was introduced as a result of soil sampling techniques at the above mentioned sites.

VOCs. The rinse blank RNSW-MW-02, associated with aqueous sampling at sites MW-03-01, MW-03-02, and MW-09-01, contained 1.3 μg/L of 1,2-dichlorobenzene. The rinse blank RNSW-MW-01, associated with aqueous sampling at site MW-08-01, contained 2.2 μg/L of 1,3-dichlorobenzene. Dichlorobenzenes were not detected in any samples, indicating the rinse blank detections had no impact on actual sample results.

Soil samples were not analyzed for VOCs.

SVOCs. No target SVOCs were reported in rinse blanks. All of the rinse blanks associated with soil and aqueous sampling contained concentrations of unknown SVOC. Concentrations of SVOC unknowns ranged from 2 to 20 μg/L. The frequency of SVOC unknowns detected in soil and aqueous rinse blanks may indicate SVOC unknowns contamination as a result of soil and aqueous sampling techniques, however, the consistency of the concentrations indicate that the source of the SVOC unknowns is not likely to be site related, and more likely to be related to source water used for rinsing the equipment or laboratory introduced contamination . Method blanks associated with soil sample SVOC analyses contained SVOC unknowns at similar concentrations. Similar concentrations of unknowns in samples are likely due to laboratory or sampling contamination.

TPH - GRO. All of the results for rinse blanks associated with soil and aqueous TPH-GRO sampling were non-detect. This indicated that there was no TPH-GRO contamination as a result of soil and aqueous sampling techniques.

TPH - DRO. The rinse blank RNSW-SS-01, associated with all surface soil sampling, contained 348 μg/L of TPH-DRO. The rinse blank RNSW-MW-02, associated with aqueous sampling at sites MW-03-01, MW-03-02, and MW-09-01, contained 105 μg/L of TPH-DRO. The results of the rinse blanks associated with soil and aqueous sampling at the above mentioned sites may indicate introduced contamination as a result of sampling techniques, however, no direct evidence linking the rinse blank contamination to DRO observed in samples was apparent. Chromatograms from the rinse blank analyses are presented in Appendix K. A diesel fingerprint is not apparent in either rinse blank. Rinse blank contamination appears as several distinct peaks. A similar pattern was observed in the soil and water rinse blank, indicating a possible relationship between the two sample collection techniques. The pattern of chromatographic pattern of peaks in the rinse blanks was not present in the samples with DRO detections. These comparisons suggest the contamination affecting the rinse blanks was not from the same source as the DRO response in the samples. No qualification of sample results was done due to the rinse blanks.

Trip Blanks

VOCs. The VOC trip blank results were non-detect for target compounds. This indicated that there was no VOC target compound contamination to samples during sample shipment to the off-site laboratory. One unknown VOC was detected at the reporting limit in VOC trip blank associated with lot VAFW. A VOC unknown was reported in the method blank associated with aqueous VOC analysis, and the presence of this unknown VOC in the trip blank is not interpreted as being related to sample shipment.

Source Water Blank

The source water blank collected from Fort Allen water supply well WW-2 was analyzed for VOCs, SVOCs, GRO, DRO and inorganics. The source water was used for equipment decontamination. With the exception of magnesium, sodium, and calcium typically present in water supplies, no target analytes were detected. These results indicate that sample contamination did not occur due to the water used during equipment decontamination.

3.2.3.5 Data Precision and Accuracy. No matrix spike or field duplicate samples were collected during the SI. Surrogate recovery results were used to evaluate the accuracy of VOC and SVOC analyses. Matrix spike/matrix spike duplicate

(MS/MSD) samples were analyzed in associated with samples submitted for USEPA Method 8015A modified for GRO and DRO. A summary of surrogate recoveries and MS/MSDs is outlined below.

SURROGATE RECOVERIES

VOCs. Surrogate recovery data was used to evaluate matrix effects and to determine the accuracy of the VOC analyses. Surrogates spiked into VOC samples included 1,2-dichloroethane-D4, 4-bromofluorobenzene, and toluene-D8. VOC surrogate recovery data are presented in Appendix K. Recovery control limits for these surrogates were compared to USEPA Contract Laboratory Program (CLP) limits presented below (USEPA, 1994):

Surrogate	Water Limits	Soil Limits
1,2-dichloroethane-D4	76% to 114%	70% to 121%
4-bromofluorobenzene	86% to 115%	74% to 121%
Toluene-D8	88% to 110%	81% to 117%

One hundred percent of the surrogate recoveries associated with aqueous VOC samples had recoveries within control limits. Soil samples were not analyzed for VOCs.

SVOCs. Surrogate recovery data was used to determine matrix effects and to determine the accuracy of the SVOC analyses. Surrogates spiked into SVOC samples included 2,4,6-tribromophenol, 2-fluorobiphenyl, 2-fluorophenol, nitrobenzene-D5, and terphenyl-D14. SVOC surrogate recovery data are presented in Appendix F. Recovery control limits for these surrogates are presented below:

Surrogate	Water Limits	Soil Limits
2-Fluorophenol	21% to 100%	25% to 121%
2,4,6-Tribromophenol	10% to 123%	19% to 122%
Nitrobenzene-D5	35%-114%	23% to 120%
2-Fluorobiphenyl	43% to 116%	30% to 115%
Terphenyl-D14	33%-141%	18%-137%

USEPA data validation guidelines (USEPA, 1988) specify that results for samples with two or more surrogate recoveries outside of control limits (acid or base-neutral)

are to be considered estimated concentrations. If a surrogate recovery was less than 10 percent, then detected SVOCs for the associated samples are to be considered estimated and non-detected SVOCs for the associated sample are to be rejected.

One hundred percent of the surrogate recoveries associated with soil and aqueous SVOC samples had recoveries within control limits.

MATRIX SPIKES/MATRIX SPIKE DUPLICATES

GRO samples submitted to the off-site laboratory were not specified for analysis of matrix spike/matrix spike duplicates (MS/MSD). However, three aqueous samples (MW-03-01, RNSW-SB-02, and WW#2 and one soil sample (SB-08-02) were selected by the off-site laboratory for MS/MSD analysis for GRO. All water samples selected for MS/MSD analysis were within laboratory-generated control limits for percent recovery and relative percent difference (RPD). Soil sample SB-08-02 had MS/MSD recoveries outside laboratory-generated control limits for percent recovery of 60% to 140%. Relative percent differences were within the RPD control limit of 20%. The percent recovery for the MS was 59%; the MSD percent recovery was 51%. These results indicate that the soil GRO results are estimated values with a possible low bias, however, results are useable with qualification.

3.2.3.6 Analytical Data Quality Evaluation. Additional data quality considerations related to the use of data generated in the off-site analytical program are presented in this subsection.

Several shipments of samples collected at the beginning of the field program arrived at the off-site laboratory with cooler temperatures greater than the 4°C preservation temperature specified in the QAPjP. Three coolers were measured with temperatures ranging from 7°C to 14°C. Samples included Level III SVOA, inorganics, DRO, and GRO, and Level II VOCs. A decision was made to analyze the samples. All sample results have been qualified "V" in accordance with USAEC and IRDMIS data flagging procedures. Samples were transferred to a 4°C storage facility at the laboratory immediately after samples were received. Based on the short time the samples were present outside the preservation temperature, sample results are considered useable for the Level II and Level III data quality uses.

Two rinse blanks, and a number of soil and water samples had DRO reported. A review of the raw laboratory chromatograms from the modified USEPA Method

8015A analyses was conducted to determine if additional information could be obtained from the data. Chromatograms from the analysis of a Fuel Oil #2 standard, the rinse blanks, and the samples are presented in Appendix K. These chromatograms indicate that sample SS-M9-01 was the only sample with a chromatogram fingerprint that matched diesel/Fuel Oil #2. Soil sample SS-LE-02 had a positive report of DRO, however, the fingerprint matches a heavy molecular weight product such as motor oil or lubrication fluid. The chromatograms from the rinse blanks and remaining soil samples with positive detections of DRO did not contain a typical diesel/Fuel Oil #2 fingerprint. The majority of the response consisted of peaks in the C18 to C32 range. There is some uncertainty associated with the nature of DRO reported in soil samples SS-LE-01, SS-09-01, and SS-WW-01. In all samples, the majority of response is beyond the range of diesel/Fuel Oil #2. The results may be indicative of traces of a highly weathered hydrocarbon with a heavier molecular weight than diesel. In groundwater sample MW-03-02, DRO was reported at 250 μg/L. A pattern of peaks was present on the chromatogram in the C10 to C18 range which may indicate the presence of dissolved fuel components. A large peak was present beyond the surrogate at approximately C-22, which may represent an additional non-fuel related compound in the sample.

Rinse blank results indicate low concentrations of DRO may be the result of sampling contamination, however, a pattern of peaks similar to those in rinse blanks was not apparent in the associated samples. Sampling related contamination may have contributed to DRO concentration reported in samples, but it was not identified as the principal cause of the DRO detection, and no qualification of results was recommended.

3.3 CHEMICAL DATA MANAGEMENT

Chemical data from the SI were managed by Quanterra Environmental Services, Inc. (the laboratory subcontractor), ABB-ES, and the USAEC's IRDMIS.

The SI generated two primary types of data:

- USEPA Level II data
- IRDMIS data from USAEC analytical methods

Sample tracking, USEPA Level II data management, and the IRDMIS are described in the following sections.

3.3.1 Sample Tracking

ABB-ES tracked the status of analyses and reporting by the off-site laboratory. Each day the field sampling teams completed the sample labels in the field, which stated the sample control number, sample identification, size and type of container, sample preservation summary, and analysis method code. The labels also provided space for sampling date and time and the collector's initials to be added at the time of collection.

Labeled samples were temporarily stored in the ABB-ES field office refrigerator. When the samples were prepared for shipment, they were recorded as being released on the COC form, which was signed, dated, and included with the samples in the shipment container.

After shipment of samples to the laboratory, ABB-ES continued to track and record the status of the samples, including the date analyzed (to determine actual holding times), the date an IRDMIS data transfer file was established by the laboratory, and the date the data were sent to IRDMIS (Section 3.3.3).

3.3.2 USEPA Level II Data Management

USEPA Level II VOC, and oil and grease data for the Phase I SI consisted exclusively of GeoProbe® soil sample data. The data were entered into an electronic spreadsheet format by Quanterra, and submitted to ABB-ES for analysis and reporting. These data were not entered into IRDMIS.

3.3.3 Installation Restoration Data Management Information System

IRDMIS is an integrated system for collection, validation, storage, retrieval, and presentation of data of the USAEC's Installation Restoration and Base Closure Program. It uses PCs, a UNIX-based minicomputer, printers, plotters, and communications networks to link these devices.

For each sample lot, ABB-ES developed a map file for the sample locations, which was entered into IRDMIS by PRI, USAEC's data management contractor.

Following analysis of the sample lot, the off-site laboratory (Quanterra) created chemical files using data codes provided by ABB-ES, and entered the analytical

results (Level 1) on a PC in accordance with the User's Manual (PRI, 1993). For each sample lot, a hard copy was printed and was reviewed and checked by Quanterra's Laboratory Program Manager. Quanterra created a transfer file from accepted records which was sent to ABB-ES (Level 2). ABB-ES performed a group and record check and sent approved records in a chemical transfer file to PRI. PRI checked the data and, if accepted, entered it into the IRDMIS minicomputer (Level 3). Level 3 data was then downloaded from IRDMIS to create hits-only data tables and final documentation reports for this report.

3.4 Applicable or Relevant and Appropriate Requirements Identification

The objective of this Phase I SI is to determine whether contamination exists at the sites of interest. An extensive evaluation of Applicable or Relevant and Appropriate Requirements (ARARs) is not specifically required for an SI, but such a comparison can be used to evaluate the need for additional investigative work and/or cleanup.

Applicable requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or Puerto Rico law that specifically address, and have jurisdiction over, a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the Fort Allen facility. Relevant and appropriate requirements are also clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or Puerto Rico law, but are not applicable (outside of authorized jurisdiction) to the conditions at Fort Allen. For example, maximum contaminant levels (MCLs) would be applicable, under the federal Safe Drinking Water Act, to water quality in a community water supply system. However, MCLs are relevant and appropriate to evaluate quality of groundwater which may be used at a residential water supply.

Selection of ARARs is dependent on the hazardous substances present at a site, site characteristics and location, and the actions selected for a remedy. Thus, ARARs can be location-specific, chemical-specific, and/or action-specific. Location-specific requirements involve restrictions established for specific substances or activities based on their location. They address circumstances such as the presence of an endangered species on the site or the location of the site in a 100-year flood plain. No location-specific ARARS were identified or developed for Fort Allen as part of this Phase I

SI. Chemical-specific ARARs are used to establish the need for cleanup (i.e., action levels) as well as to define cleanup goals. Action-specific requirements involve performance, design, or other action-specific requirements and are generally technology- or activity-based. They are used to control or restrict particular types of remedial actions selected as alternatives for cleanup of a site. Action-specific requirements were not evaluated as a part of this Phase I SI Report, as possible remedial actions have not yet been identified.

ARARs identified for this SI are chemical-specific ARARs for groundwater. ARARs for chemicals detected in groundwater at Fort Allen are listed in Table 3-4. In summary, the evaluation criteria adopted by ABB-ES for groundwater include federal MCLs and Puerto Rico groundwater quality regulations.

Comparisons of groundwater analytical results to ARARs is included in subsequent sections of this report.

4.0 FORMER NAVY LANDFILL

As presented in the PA Report (Weston, 1994), the U.S. Navy operated a landfill in the extreme northwestern portion of Fort Allen (see Figure 1-2) from June 1974 to June 1980. The Former Navy Landfill was identified as AOC 1 in the 1996 Site Investigation Report (USARTAC, 1996a). This landfill is located north of the east-west runway on the west side of the Navy communication facility access road, and covered approximately 4 acres in a relatively flat, open area with a gentle slope providing limited drainage to the southeast. Records are incomplete regarding the specific landfill operating practices, but it was reportedly used for the disposal of garbage and construction debris (Weston, 1994). Interviews with site personnel and review of available records failed to produce evidence to document or refute the possibility that hazardous wastes may have been deposited into the former Navy Landfill (Weston, 1994).

As indicated in Section 1.0, investigations at the Former Navy Landfill are proposed for a Phase II SI, due to safety concerns and the need for additional pre-investigation scoping activities. Therefore, no investigation activities were conducted at this study area as part of the Phase I SI.

5.0 FORMER IMMIGRATION AND NATURALIZATION SERVICE (INS) LANDFILL

As presented in the PA Report (Weston, 1994), the INS operated a landfill from 1981 to 1982 in the central portion of Fort Allen between the two former air field runways (see Figure 1-2). The Former INS Landfill was identified as AOC 2 in the 1996 Site Investigation Report (USARTAC, 1996a). This landfill covered approximately 7 acres in a relatively flat, open area with a gentle slope providing limited drainage to the southeast. Records are incomplete regarding the specific landfill operating practices, but it was reportedly used for the disposal of garbage and construction debris (Weston, 1994). Operating practices were probably consistent with those at the time the Former Navy Landfill was closed. Interviews with site personnel and review of available records failed to produce evidence to document or refute the possibility that hazardous wastes may have been deposited into the former INS Landfill (Weston, 1994).

As indicated in Section 1.0, per agreement with the U.S. Army, the U.S. Navy has agreed to conduct investigations at the Former INS Landfill as part of a proposed ROTHER antenna installation. Therefore, no investigation activities were conducted at this study area as part of the Phase I SI, and antenna installation activities have not as yet provided investigatory information.

6.0 ORGANIZATIONAL MAINTENANCE SHOP #9 (OMS#9), BUILDING 342

Organizational maintenance is currently the only non-training activity that takes place on Fort Allen (Weston, 1994). This activity has historically occurred at OMS #9, which is located in and around Building 342, in the center of the cantonment area (see Figure 1-3 and 6-1). Other buildings within OMS #9 are Building 367 (Paint storage), and Building 349. The site plan for OMS #9 is presented as Figure 6-1. The function of the OMS is to perform routine light maintenance on military vehicles (Weston, 1994). This generally involves changing and/or refilling engine fluids, vehicle lubricants, battery replacement, minor routine parts installation, and replacing brake linings.

The following subsections present the findings of the Phase I SI conducted at this study area during the November - December 1996 field program.

6.1 STUDY AREA BACKGROUND AND CONDITIONS

Building 342 is a concrete and steel structure with five service bays openings to the maintenance yard. Building 342 has concrete floors that slope to floor drains which are connected to an oil/water separator. Any liquid waste spill inside the building would most likely flow to the floor drains and be routed to the oil/water separator. Several fenced-in storage/maintenance lots are connected to Building 342 and are used by OMS #9 for storage and maintenance. These lots are constructed of concrete with centrally located storm drains that drain from the site into open drainage channels. The concrete is cracked in many places and is overgrown with grass.

Changing of vehicle oil is performed within Building 342, unless all bays are full, in which case oil changes are made in the maintenance yard on vehicle grease racks in the northeast corner of the study area (see Figure 6-1). Used motor oil and oil filters are stored on 55-gallon drums, on wood pallets, over sand-filled wooden drip catch boxes. Waste oil drums are transported off-site for disposal by a contractor (Weston, 1994). The maximum number of used oil drums on-site at one time is six, for a total of 330 gallons (Weston, 1994). No records of spills were found during the PA or during this Phase I SI.

Used vehicle batteries are also replaced at OMS #9. New and old batteries were being stored outdoors in the northwest corner of the maintenance yard at the time of the PA site visit in 1994 (see Figure 6-1). No evidence of battery storage was observed in this area during the Phase I SI. Worn brake linings are also replaced at OMS #9, used brake shoes are placed into a 55-gallon drum and stored on pallets in the maintenance yard awaiting proper disposal (Weston, 1994).

Operations at OMS #9 also periodically includes parts cleaning in a bin located within Building 342 (Weston, 1994). The bin reportedly holds approximately 40 gallons of solvent and is periodically changed, with the spent solvent being placed into 55-gallon drums stored on pallets adjacent to the waste oil awaiting removal/disposal by a contractor (Weston, 1994).

Two virgin product storage areas are located within OMS #9. One of these storage areas is a flammable storage shed and several containing cans of paint, cleaning solvents, cutting and lubricant oil and fluids (Weston, 1994). Materials such as oils, lubricants and grease in containers ranging from one gallon to 55-gallon drums are stored outside of the storage shed. During the PA site visit in 1993, it was estimated that 250-gallons of materials were stored outside. The second virgin product storage is in Building 367, which is a wooden shed with tile floor, and no floor drain (see Figure 6-1). This shed is used to store paints, acetone, and sealing compounds, including silicone sealant. During the PA it was estimated that 300-gallons of materials was stored in the shed. Spills from either of the sheds described above will reach the maintenance yard.

Three washracks are located within OMS #9 (Weston, 1994). The washracks are connected to an oil/water separator and the oil/water separator discharges into the sanitary sewer (Weston, 1994). Effluent from the oil/water separator flows via a sanitary sewer to the Fort Allen WWTP for treatment.

A vehicle refueling facility (former Gas Station No. 1) was formerly operated at the entrance of OMS #9 (see Figure 6-1). The petroleum storage system consisted of a 5,000-gallon UST containing MOGAS, piping and two dispensers. During the Phase I SI, this facility was no longer in use, and the dispensers have been removed from the site. No information was available regarding the system construction, fuel inventory, and monitoring of the petroleum storage system. Fueling is currently completed at the facility by dispensing fuel from tanker trucks parked in a bermed concrete containment pad located in the southwestern corner of the study area.

6.2 SITE INSPECTION PROGRAM SUMMARY

The SI at OMS #9 was completed in December 1996, in accordance with the provisions of Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program completed at OMS #9 was designed to evaluate the presence or absence of contaminants associated with the vehicle grease racks, bermed concrete storage pad, bermed concrete containment pads for fueling vehicles, the paint storage shed, and storm water catchment basin (see Figure 6-1). Table 6-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of the collection of five GeoProbe® subsurface soil samples, drilling of a soil boring to characterize soils and to collect a subsurface soil sample, collection of one surface soil sample and the installation and recovery of six soil vapor probes.

One surface soil sample (SS-M9-01) was collected near the bermed concrete containment pad in the southwestern part of OMS #9, where vehicles are fueled (see Figure 6-2). During the SI field program, soil staining and a strong diesel order was noted on the south side of the containment area where a gate valve was located. The gate valve is used to empty rain water from the containment area.

A GeoProbe® was utilized to collect subsurface soil samples at five separate locations (GP-M9-01 through GP-M9-05) near potential contamination sources (see Figure 6-2). A summary of the GeoProbe® borings drilled at OMS #9 is presented as Table 6-2. Samples at each boring were collected from ground surface to 10 feet bgs. These soil samples were collected to evaluate potential contamination associated with a storm water catchment basin, the paint storage building (Building 367), the vehicle grease racks, and the bermed concrete containment pad used for fuel truck storage. One subsurface soil sample from each boring was submitted for off-site laboratory USEPA Level II analysis of VOCs, and oil and grease. GeoProbe® data records are presented in Appendix A.

One soil boring (SB-M9-01) was drilled using a trailer mounted drilling rig within the area of the vehicle grease rack located in the northeast corner of OMS #9 (see Figure 6-2). The objective of this soil boring was to characterize the subsurface soil and to collect a subsurface soil sample for off-site laboratory analysis by USAEC-

approved methods for SVOCs, GRO, DRO, and inorganics. Table 6-3 presents a summary of the soil boring.

Six soil vapor probes (SV-M9-01 through SV-M9-06) were installed at several locations within OMS #9. Soil vapor probes were installed at or near the vehicle grease racks, the former storage pads, and the paint storage building (Building 367) to evaluate soil vapors at the site (see Figure 6-2). The soil vapor probes were placed in areas where handling and storage hazardous materials and hazardous waste were likely. Soil vapor probes were left in the ground for 17 days. Soil vapor probes were then recovered and shipped to an off-site laboratory for analysis of VOCs and SVOCs by GC/MS.

6.3 Field Investigation Results and Observations

The subsurface soils encountered during drilling of the soil boring and GeoProbe® soil borings consist of a brown to black organic clay with high plasticity, grading into a silty clay with medium to high plasticity as depth from ground surface increases. Soil boring logs are presented in Appendix B. Appendix A contains the GeoProbe® data records, which describe the soil samples encountered at OMS #9.

Based on the water-level survey of groundwater monitoring wells installed during this Phase I SI (MW-03-01, MW-03-02, MW-08-01, and MW-09-01), it is estimated that the groundwater beneath OMS #9 flows towards the southeast (see Figure 3-1). Based on the depth to water in the groundwater monitoring well at AOC 9 (MW-09-01) and the topography of the cantonment area, the depth to water at OMS #9 is estimated to be 13 feet bgs. No groundwater monitoring wells were installed at OMS #9 as part of the Phase I SI.

6.4 Nature and Distribution of Contamination

The objectives of the sampling program at OMS #9 were to evaluate the presence or absence of potential contamination caused by any discharges of hazardous materials or hazardous waste that might have occurred at OMS #9. The primary concern at OMS #9 is that hazardous materials, hazardous waste, or fuel-related compounds may be impacting the quality of the soil and groundwater in the vicinity of OMS #9. In considering the potential contaminant migration pathways, it was

determined that the most likely pathways for contaminant migration would be infiltration into subsurface soil and potential horizontal transport by groundwater movement.

6.4.1 Surface Soil

Review of analytical results from surface soil sample SS-M9-01, collected near the bermed concrete fueling truck pad (see Figure 6-2), indicate the presence of diesel fuel-related compounds (Table 6-4). The presence of these compounds is in agreement with field observations of staining and a strong diesel fuel odor at the sampling location. DRO was detected at a concentration of 1260 μg/g, and GRO was detected at a concentration of 10.6 μg/g. DRO was also detected in the rinse blank (RNSW-SS-01), but is interpreted not be attributable to the DRO detected in the sample. Other organic compounds detected in the SVOC range include eicosane (5 μg/g), hexadecane (10 μg/g), octadecane (9 μg/g), tridecane (9 μg/g), tetradecane (9 μg/g), heptadecane (9 μg/g), nonadecane (9 μg/g), heneicosane (5 μg/g), and tricosane (9 μg/g). These SVOCs are long-chain hydrocarbons, likely associated with the spilled diesel fuel. Numerous SVOC unknowns were reported in the sample, and are likely attributable to the diesel fuel. Lead was detected in the sample at a concentration of 25 μg/g. Other inorganic analytes detected in the sample are presented in Table 6-4.

6.4.2 Subsurface Soil

Results of GeoProbe® and soil boring (SB-M9-01) sample off-site laboratory analyses are presented in the following subsections. Analytes detected in GeoProbe® samples are presented in Table 6-5, and analytes detected in soil boring SB-M9-01 are presented in Table 6-6.

6.4.2.1 GeoProbe® Borings GP-M9-01 through GP-M9-05. The only detection of VOCs in the GeoProbe® subsurface soil samples at OMS #9 was in boring GP-M9-01, collected from 6 to 10 feet bgs, at a location between the vehicle grease rack ramps in the northeast corner of OMS #9 (see Figure 6-2). Ethylbenzene was detected at a concentration of 1700 micrograms per kilogram (μg/kg), and total xylenes at a concentration of 1100 μg/kg (se Table 6-5). Other fuel-related VOCs may be present at lower concentrations, however, sample dilution raised the quantitation limits for other VOC analytes. Oil and grease was not detected above

the quantitation limit of 100 μg/kg in any of the GeoProbe® subsurface soil samples analyzed.

6.4.2.2 Soil Boring SB-M9-01. The analytical sample from soil boring SB-M9-01 was collected from a depth of 10 to 12 feet bgs, between the vehicle grease rack ramps in the northeast corner of OMS #9 (see Figure 6-2). Analytical results for SVOC target analytes, GRO, and DRO were below the off-site laboratory certified reporting limits (Table 6-6). SVOC unknowns were reported in the sample at a total concentration of approximately 19 μg/g. However, these are not likely to be sample related, as SVOC unknowns were detected at similar concentrations in the laboratory method blank (see Subsection 3.2.3.4). Inorganic analyte concentrations are comparable to concentrations in other subsurface soil samples collected during the Phase I SI.

6.4.3 Soil Vapor Survey

As indicated in Subsection 3.2.1, soil vapor survey analytical results were blank-corrected prior to assessment of soil vapor contamination. Soil vapor survey analytical results are presented in Appendix C. Blank-corrected analytical results from the six soil vapor probes indicate the positive detection of acenaphthene, chloroform, and perchloroethylene. None of these analytes were detected in the trip or method blanks. Acenaphthene was detected in SV-M9-01, which is adjacent to GeoProbe® boring GP-M9-01, in which fuel-related VOCs were detected (see Subsection 6.4.2.1). Chloroform was detected in SV-M9-02 (near the vehicle grease rack in the northeastern corner of OMS #9), SV-M9-03 (adjacent to bermed concrete storage pad in the northeastern corner of OMS #9), and SV-M9-06 (between the southern vehicle grease rack an Building 349)(see Figure 6-2). Perchloroethylene was detected in SV-M9-04 (north of Building 367); this was the only detection of this VOC in the nineteen soil vapor probes installed and analyzed during the Phase I SI.

6.5 Source Evaluation and Migration Potential

Review of the analytical results indicates the presence of several potential source areas at OMS #9. Evaluation of these potential sources, and associated migration potentials, are discussed as follows.

Fuel-related VOCs and acenaphthene, and the chlorinated VOC chloroform were detected in the subsurface soils at the vehicle grease rack in the northeastern corner of OMS #9 (see Figure 6-2). These contaminants are likely the results of maintenance activities in this area. Fuel-related contamination detected beneath the vehicle grease rack has the potential to migrate to the water table (estimated to be 13 feet bgs) via infiltrating precipitation and soil vapor. The vertical extent of the contamination identified at GeoProbe® boring GP-M9-01 was not identified. However, if contaminants were to reach the water table, migration with the groundwater in an estimated southeast direction is presumed.

Observations of soil staining and fuel odors near the bermed concrete fuel truck pad (see Figure 6-2), indicate the presence of diesel fuel-related compounds. DRO and long-chain hydrocarbons detected in the sample indicate contamination by fuel-related compounds. Fuel-related contamination beneath the study area has the potential to migrate to the water table via infiltrating precipitation and soil vapor.

Soil vapor survey results from probe SV-M9-04 reported perchloroethylene in the subsurface soil vapor north of Building 367, which has historically been used for storage of paint and supplies. While perchloroethylene was not detected in soil samples south of the building, its use or storage at a paint shop is not unexpected. If present in sufficient quantities, perchloroethylene would be expected to migrate to, and transport with, groundwater.

6.6 Conclusions and Recommendations

The primary concern at OMS #9 is the potential contamination of subsurface soil and groundwater by fuels and organic compounds as a result of vehicular maintenance activities and storage of hazardous materials and waste. Subsurface soil contamination by fuel-related compounds is present at the vehicle grease rack in the northeastern corner of OMS #9 (see Figure 6-2). Diesel fuel-related contamination was detected in surface soil near the bermed concrete fuel truck pad in the southwest corner of OMS #9. The detection of perchloroethylene in the subsurface soil vapor north of Building 367, which has historically been used for storage of paint and supplies, indicates the potential for subsurface contamination in this area.

Based on the results discussed previously, additional GeoProbe® borings to the water table are recommended to delineate the fuel-related subsurface soil contamination

at the vehicle grease rack in the northeastern corner of OMS #9, and at the bermed concrete fuel truck pad in the southwest corner of OMS #9. It is also recommended that groundwater conditions be investigated, through direct push or monitoring well sampling systems, downgradient of these sites and along the southern boundary of OMS #9 near Building 342 to determine groundwater flow direction and evaluate groundwater quality. Historical activities within Building 342 may also have impacted the subsurface surrounding this building (see Figure 6-1). The potential for contamination associated with historical activities within, and immediately adjacent to, Building 342 were not addressed in the scope of this Phase I SI. Evaluation of groundwater quality near Building 367 (paint storage) is also recommended as a result of perchloroethylene detection in soil vapor probe SV-M9-04.

7.0 BUILDING 358, PAINT AND CHEMICAL STORAGE ROOM

Building 358, which contains the Paint and Chemical Storage Room, is located on the western edge of the cantonment area at Fort Allen (see Figures 1-3 and 7-1). The following subsections present the findings of the Phase I SI conducted at this study area during the November - December 1996 field program.

7.1 STUDY AREA BACKGROUND AND CONDITIONS

Building 358 is a concrete structure and is used as a general warehouse for all the non-perishable supplies that are used at Fort Allen. On the east side of the building is an approximate 12-foot by 12-foot below grade (sunken) storage room with a metal roll-up door (Weston, 1994). This room is used for the storage of flammable materials such as paints, adhesives, and sealants that are being stored awaiting use. Hazardous chemicals are stored in metal or plastic containers, ranging in size from one-pint to five-gallons, on wooden pallets or metal shelves (Weston, 1994). No floor drains were noted in the storage room (Weston, 1994).

The topography surrounding Building 358 is flat, with a slight slope to the southeast. Consequently, surface water runoff appears to drain southeast, following the topography and/or infiltrating into the ground. It does not appear that there are any surface water pathways from Building 358 to any surface water bodies.

In 1996, a petroleum UST was removed from the east side of the building by the PRARNG and four groundwater monitoring wells were installed to evaluate groundwater quality in the UST area. No information was available during the Phase I SI regarding the water quality in the former UST area. The status of the UST program at Fort Allen is presented in Section 10. Former Gas Station No. 2 is located approximately 30 meters to the east, and AOC 9 is to the north and west of Building 358.

7.2 SITE INSPECTION PROGRAM SUMMARY

The SI for Building 358, including the Paint and Chemical Storage Room, was completed in December 1996, in conformance with the provisions of the Fort Allen

Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program conducted at Building 358 was designed to evaluate the presence or absence of contaminants associated with the storage and handling of hazardous materials discussed in Section 7.1. Table 7-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of collection of four GeoProbe® subsurface soil samples, and the installation and recovery of five soil vapor probes (Figure 7-2). The exploration locations were selected during the SI field program based on visual observation of the site and activities conducted for transporting hazardous materials in and out of the building.

A GeoProbe® was utilized to collect subsurface soil samples at four locations (GP-PC-01 through GP-PC-04) around the Building 358. A summary of GeoProbe® borings drilled at Building 358 is presented as Table 7-2. The GeoProbe® subsurface soil samples were collected from ground surface to 10 feet bgs. These soil samples were collected to evaluate potential contamination associated with the possible discharge of hazardous materials. One subsurface soil sample from each boring was submitted for off-site laboratory USEPA Level II analyses of halogenated VOCs, and for on-site analysis of BTEX by immunoassay (see Table 7-2). The GeoProbe® data records are presented in Appendix A.

Five soil vapor probes (SV-PC-01 and SV-PC-05) were installed around the perimeter of Building 358 to evaluate soil vapors surrounding the building. The soil vapor probes were placed in areas where historic handling or storage of hazardous materials was suspected. The soil vapor probes were left in the ground for 17 days, then shipped to an off-site laboratory for analysis of VOCs and SVOCs by GC/MS.

7.3 Field Investigation Results and Observations

The subsurface soils encountered during the drilling of the GeoProbe® borings in the vicinity of Building 358 are characterized by a brown, slightly plastic, sandy clay to a depth of 10 feet bgs. Subsurface soil samples were collected from 0 to 4, 4 to 6 and 6 to 10 feet bgs and screened with a PID. Soil samples screened with the PID were below detectable limits (less than 1 ppm) (see Table 7-2). No visual signs of contamination were observed in the subsurface samples.

Based on a water level survey of all the monitoring wells installed during this Phase I SI (MW-03-01, MW-03-02, MW-08-01, and MW-09-01), the groundwater flow direction at Building 358 is assumed to be to the south-southeast (see Figure 3-1). Depth to water was measured at the monitoring wells installed in the former UST area by the PRARNG, and was found to be 12.9 feet bgs on November 14, 1996.

7.4 Nature and Distribution of Contamination

The objective of the sampling program at Building 358 was to investigate the presence or absence of contamination potentially caused by the storage and handling of hazardous materials. The primary concern at Building 358 is the Paint and Chemical Storage Room and contamination generated from any spill that may have occurred, potentially impacting the quality of the soil and groundwater. In considering potential contaminant migration pathways, it was determined that the most likely pathway for contaminant migration would be subsurface soil and groundwater. The presence or absence of VOCs and SVOCs in the vadose zone was investigated by using soil vapor probes, and by monitoring subsurface soil samples with a PID. Subsurface soil samples were collected for chemical analysis from exploration locations around the perimeter of the building at a depth of 6 to 10 feet bgs to evaluate potential contamination.

7.4.1 Subsurface Soil

USEPA Level II halogenated VOC analytical results for subsurface soil samples (GP-PC-01 through GP-PC-04) collected around Building 358 are presented in Table 7-3. Halogenated VOCs were not detected above the quantitation limits in any of the subsurface soil samples collected. PID field screening results for all subsurface soil samples (depth interval 0 to 10 feet bgs) were also negative (see Table 7-2).

Results of immunoassay test kit analyses for total BTEX equivalents in the 6 to 10-foot bgs samples were also negative. All results indicated total BTEX equivalents concentrations were less than the quantitation limit of 2.5 ppm (see Appendix I).

7.4.2 Soil Vapor Survey

As indicated in Section 3.2.1, soil vapor survey analytical results were blank-corrected prior to assessment of soil vapor contamination. Soil vapor survey analytical results

are presented in Appendix C. Blank-corrected analytical results from the five soil vapor survey probes indicate the positive detection of toluene and tridecane in probes SV-PC-01 and SV-PC-02, near the northwest corner of Building 358 (see Figure 7-2). Chloroform was the only compound detected in probe SV-PC-05, on the east side of the building. During installation of SV-PC-05, a PID reading of 10 ppm was observed in the probe installation hole. Soil vapor analytical results were negative in probes SV-PC-03 and SV-PC-04 (in the vicinity of a former UST) around the southeast corner of Building 358.

7.5 Source Evaluation and Migration Potential

Subsurface soil sample analytical results do not indicate the presence of a subsurface contamination source area at the exploration locations from ground surface to a depth of 10 feet bgs. However, review of soil vapor survey results indicate the potential for fuel-related and chloroform source area(s) in the vicinity of Building 358. If present, these contaminants would be expected to volatilize or leach to, and transport with, groundwater.

7.6 Conclusions and Recommendations

The primary concern at Building 358, which includes the Paint and Chemical Storage Room, is the possible contamination of subsurface soil and groundwater resulting from potential historic storage and/or spills of hazardous materials. No contamination was detected in shallow (0-10 ft bgs) subsurface soils adjacent to Building 358. However, based on soil vapor survey results, fuel-related and chloroform source area(s) may be present in the vicinity of Building 358.

Based on the results and findings mentioned above, it is recommended that groundwater data from the four monitoring wells installed by PRARNG on the southeastern side of the building (see Figure 7-2) be reviewed for a preliminary evaluation of groundwater quality. These wells are located down- and cross-gradient of Building 358 (see Figures 3-1 and 7-2). The groundwater monitoring data was not available at the time of Phase I SI completion. Review of the data may provide insight into potential contamination at Building 358, and the need for any additional explorations and sampling.

8.0 BUILDING 360, PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

Building 360 and the surrounding lot in the northwest corner of the cantonment area had been used by Fort Allen as mixing and storage areas for pesticides and herbicides for an undetermined number of years (Figures 1-3 and 8-1). The following subsections present the findings of the Phase I SI conducted at this study area during the November - December 1996 field program.

8.1 STUDY AREA BACKGROUND AND CONDITIONS

The Pesticide/Herbicide Mixing and Storage Area was formerly fenced, and the surface currently consists of a mixture of gravel, grass, and broken asphalt. The former structure, Building 360, was an open concrete and wood structure with a fiberglass and asphalt shingle roof, located along the eastern edge of the study area. Operations in this area historically involved mixing and storage of pesticides and herbicides in 55-gallon drums (Weston, 1994). Drums were typically stored upright on wooden pallets under the cover of Building 360. At the time of the PA site visit (1993), this area contained approximately fifteen 55-gallon drums of various products including herbicides, oils and lubricants. Several of the drums were rusting and corroding, and some were stored on their sides (Weston, 1994). At the time of the PA site visits, no secondary containment was evident. In addition, it was observed that safe hazardous chemical storage practices were not being implemented in this area (Weston, 1994). Visual inspection of the Pesticide/Herbicide Mixing and Storage Area during the PA did not produce evidence that a spill had occurred, but a release to the environment from this area could be expected (Weston, 1994).

During the SI the former Pesticides/Herbicide Mixing and Storage area was an open, paved area in which the Fort Allen personnel stored large piles of brush. Foundations of the former open concrete structure were found along the eastern edge of the site. No evidence of pesticide/herbicide mixing or storage activities was observed. The study area is higher than the paved road on the south boundary, and drainage from the site appears to be to the south, toward the road, and east toward the flat, grassy area adjacent to the eastern boundary of the Study Area (see Figure 8-1). Observations indicate no obvious pathways for runoff to reach any surface water body. Runoff from the site likely infiltrates the ground surface and/or follows the paved road to the west.

8.2 SITE INSPECTION PROGRAM SUMMARY

The Phase I SI at the pesticides/herbicide mixing and storage area was completed in December 1996, and in conformance with the provisions of Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program conducted at the Pesticide/Herbicide Mixing and Storage Area was designed to evaluate the presence or absence of contaminants associated with the potential release of pesticides and herbicides into the environment. Table 8-1 summarizes the technical approach and rationale for the sample and exploration locations.

The field program consisted of the collection of three GeoProbe® subsurface soil samples, one subsurface soil sample collected from a soil boring and the installation and collection of four soil vapor probes. The areal extent of the Pesticide/Herbicide Mixing and Storage Area was identified in the field by the former fence post locations and the foundations of the former building.

A GeoProbe® was utilized to collect subsurface soil samples at three locations (GP-PH-01 through GP-PH-03) within the study area (see Figure 8-2). A summary of GeoProbe® borings drilled at the Pesticide/Herbicide Mixing and Storage Area is presented as Table 8-2. Subsurface soil samples from each boring were submitted for off-site laboratory USEPA Level II analyses of VOCs, and oil and grease. The GeoProbe® data records are presented in Appendix A.

One soil boring (SB-PH-01) was drilled using a trailer mounted rig within the area of the former building to characterize the subsurface soil, and to collect a subsurface soil sample for off-site laboratory analyses by USAEC-approved methods for SVOCs, GRO, DRO, and metals. Table 8-3 presents a summary of the soil boring.

Four soil vapor probes (SV-PH-01 through SV-PH-04) were installed at locations within the Pesticide/Herbicide Mixing and Storage Area to evaluate subsurface soil vapors beneath the study area (see Figure 8-2). The soil vapor probes were placed in areas where former handling and storage of pesticides and herbicides is suspected. The soil vapor probes were left in the ground for 17 days. Soil vapor probe SV-PH-01 was installed near the brush pile. Between the time of installation and the time of recovery, Fort Allen personnel moved the pile of brush, and as a result, soil vapor probe SV-PH-01 could not be found. The recovered soil vapor probes (SV-PH-02 through SV-PH-04) were shipped to an off-site laboratory for analysis of VOCs and SVOCs by GC/MS.

8.3 Field Investigation Results and Observations

The subsurface soils encountered during the drilling of the GeoProbe® borings and the soil boring (SB-PH-01) beneath the former Pesticide/Herbicide Mixing and Storage Area is characterized by a brown, medium- to coarse-grained, sandy clay and silty clay, of high to medium plasticity to a depth of 10 feet bgs. Subsurface soil samples were screened with a PID and all soil samples were below detectable limits (less than 1 ppm) (see Tables 8-2 and 8-3). No visual signs of contamination were observed any subsurface in soil sample.

Based on a water level survey of the monitoring wells installed during this Phase I SI (MW-03-01, MW-03-02, MW-08-01, and MW-09-01), the groundwater flow direction in the Pesticide/Herbicide Mixing and Storage Area is anticipated to be to the south-southeast (see Figure 3-1). Based on the depth to water in the groundwater monitoring well at AOC 9 (MW-09-01) and the topography of the cantonment area, it is estimated that the depth to the water table at the study area is approximately 13 feet bgs. No groundwater monitoring wells were installed at the Pesticide/Herbicide Mixing and Storage Area as part of the Phase I SI.

8.4 Nature and Distribution of Contamination

The sampling program at the former Pesticide/Herbicide Mixing and Storage Area was designed to evaluate the presence or absence of potential contamination caused by the historical mixing and storage of herbicides and pesticides. The primary concern at the study area is that the mixing and storage of pesticides and herbicides may be impacting the quality of the soil and groundwater at the site. In considering the potential contaminant migration pathways, it was determined that the most likely pathway for contaminant migration would be vertical infiltration through subsurface soil and horizontal transport by the groundwater under the site. Subsurface soil samples were collected for analysis to evaluate potential leaching of contaminants (see Figure 8-2). In addition, soil vapors were monitored in the vadose zone to evaluate the presence or absence of VOCs and SVOCs.

8.4.1 Subsurface Soil

Results of soil sample immunoassay analyses and soil boring sample off-site laboratory analyses are presented in the following subsections. Immunoassay test results are presented in Appendix I, and analytes detected in soil boring SB-PH-01 are presented in Table 8-4.

8.4.1.1 GeoProbe® Borings GP-PH-01 through GP-PH-03. BTEX was detected in the 0 to 4-foot bgs sample from boring GP-PH-02 at a concentration between 11 and 20 ppm (total BTEX equivalents). Analytical results of immunoassay test kit analyses for BTEX in the 0 to 4-foot bgs samples from GP-PH-01 and GP-PH-03 were less than the quantitation limit of 2.5 ppm.

PCBs and chlordane were not detected in any of the 0 to 4-foot bgs samples from GP-PH-01 through GP-PH-03. All results for the PCB immunoassay tests were less than the quantitation limit of 0.5 ppm. All results for the chlordane immunoassay tests were less than the quantitation limit of 0.020 ppm.

Tentative confirmation of DDT was reported for two samples with the immunoassay test kits (see Subsection 3.2.2). Results of the two tests run on the GeoProbe® samples yielded tentative positive confirmation of DDT in the GP-PH-01 and GP-PH-02 samples. BTEX was also detected in the sample from GPH-02 (see above).

8.4.1.2 Soil Boring SB-PH-01. The analytical samples from soil boring SB-PH-01 was collected from a depth of 5 to 7 feet bgs. Analytical results for all SVOCs, GRO, and DRO were below the off-site laboratory certified reporting limits (Table 8-4). Inorganics detected in the sample include are presented in Table 8-4. None of the inorganic analyte concentrations appear to exceed the range detected in other subsurface soil samples collected during the Phase I SI.

8.4.2 Soil Vapor Survey

As indicated in Section 3.2.1, soil vapor survey analytical results were blank-corrected prior to assessment of soil vapor contamination. Soil vapor survey analytical results are presented in Appendix C. Blank-corrected analytical results from the three recovered soil vapor probes (SV-PH-02 through SV-PH-04) indicate the positive detection of benzene, toluene, m,p-xylene, tridecane, pentadecane, trimethylbenzenes, and octane. Relative concentrations of these analytes are highest in soil vapor

probes SV-PH-03 and SV-PH-04, along the northern edge of the study area (see Figure 8-2). Relative concentrations of BTEX are highest in SV-PH-04. During installation of SV-PH-04, a PID reading of 1 ppm was observed in the probe installation hole.

8.5 SOURCE EVALUATION AND MIGRATION POTENTIAL

Subsurface soil sample off-site analytical results did not detect the presence of a specific subsurface contamination source area. However, based on immunoassays, detection of BTEX at GP-PH-02, and the detection of fuel-related compounds in soil vapor samples, there is probable fuel contamination in the subsurface soils beneath the study area. In addition, there is immunological evidence of DDT in the subsurface soils. DDT would not be expected to migrate extensively in the subsurface soil or groundwater. Fuel-related contamination beneath the study area has the potential to migrate to the water table via infiltrating precipitation and soil vapor. However, the study area is partially paved, which limits the amount of infiltrating precipitation. If contaminants were to reach the water table, migration with the groundwater (in a predicted southeast direction) is probable.

8.6 CONCLUSIONS AND RECOMMENDATIONS

The primary concern at the former Pesticide/Herbicide Mixing and Storage Area is the potential contamination of subsurface soil and groundwater by pesticides, herbicides and fuels as a result of former mixing and storage activities. BTEX was detected in the shallow subsurface soils of GP-PH-02, and DDT was tentatively identified in samples from GP-PH-02 and GP-PH-03. Soil vapor survey results detected the presence of fuel-related contamination beneath the study area.

Based on the results and findings mentioned above, additional GeoProbe® borings to the water table are recommended to further assess potential subsurface soil contamination. It is also recommended that groundwater quality be assessed downgradient of the study area.

9.0 LEAKING ELECTRICAL TRANSFORMER

Since the entire facility was used for most of its active life as a Naval Communications Stations, it is assumed that numerous electrical transformers are located throughout Fort Allen (Weston, 1994). Records from the U.S. Navy indicate that the Naval Communication Station that is currently active at Fort Allen contained six electrical transformers that tested positive for PCBs in 1983 at levels ranging from less than 2 ppm to 10 ppm. According to the Navy personnel, these six transformers were retrofitted with non-PCB containing fluid in 1989 (Weston, 1994). Several Fort Allen representatives indicated in 1993 that all of their transformers were tested and replaced with non-PCB containing transformers on as-needed basis, but documentation was not available to confirm that transformers were tested and fluids on transformers replaced (Weston, 1994).

Documentation from a U.S. Army Water Quality Survey indicates that in 1984 a leaking transformer was present in the vicinity of one of Fort Allen's active drinking water wells (AEHA, 1984).

9.1 Study Area Background and Conditions

The suspected leaking electrical transformer supply electricity to Fort Allen's potable water system located in the center of the cantonment area (see Figure 1-3). Three transformers are located approximately 30 feet to the north of Building 338 (the water treatment plant). Fort Allen potable water supply wells #1 and #2 (WW#1 and WW#2) are located within a 150-foot radius of the transformers. The transformers are surrounded by a locked, eight-foot high fence for safety and security reasons. The 10-foot by 10-foot fenced area is otherwise unsheltered. The ground surface under the transformers is covered with 3/4-inch limestone gravel. The transformers are mounted on a concrete foundation, which is elevated approximately eighteen inches above the ground surface.

9.2 Site Inspection Program Summary

The Phase I SI at the potable water system transformer site was completed in November of 1996, in conformance with the provisions of the Fort Allen Technical

Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program was designed to evaluate the presence or absence of potential contamination in surface soils. Table 9-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program for the suspected leaking transformer(s) consisted of the collection of two surface soil samples (SS-LE-01 and SS-LE-02) for off-site laboratory analysis. Surface soil samples were collected on each side of the bank of the concrete foundation which supports the three transformers. The limestone gravel was removed at the sample locations to allow for sampling of the silty material beneath the gravel. Both samples were shipped to an off-site laboratory for analysis by USAEC-approved methods for SVOCs, GRO, DRO, and inorganics, as indicated in the Technical Plan (ABB-ES, 1996a).

9.3 Field Investigation Results and Observations

The collection of surface soil samples SS-LE-01 and SS-LE-02 were the only activities conducted at this study area. No visual signs of staining were apparent in the soil samples. PID screening of the samples did not result in the detection of any VOCs.

Based on the water level survey of groundwater monitoring wells installed during this Phase I SI, it is estimated that the groundwater flow direction is to the southeast across the central portion of the cantonment area (see Figure 3-1). It is assumed that the groundwater flow direction beneath the transformer site is to the southeast, although groundwater flow direction in the area may be influenced by pumping of nearby potable water wells WW#1 and WW#2.

9.4 Nature and Distribution of Contamination

The objective of the sampling program at the potential leaking electrical transformer was to investigate the presence or absence of potential contamination. The primary concern at the leaky electrical transformer site is that contaminants may be impacting the quality of the soil and groundwater at this site. In considering the potential contaminant migration pathways, surface soil samples were collected to evaluate the presence or absence of contamination in the soil.

Analytical results from surface soil samples SS-LE-01 and SS-LE-02 indicate detection of fuel-related compounds, pesticides, mercury, and lead (Table 9-2). DRO was detected at concentrations of 8.95 $\mu g/g$ (SS-LE-01) and 45.3 $\mu g/g$ (SS-LE-02). Review of the DRO chromatogram for sample SS-LE-02 indicates the presence of heavy straight-chain hydrocarbons, which matches a heavy molecular weight product such as motor oil or lubricating fluid (see Subsection 3.2.3.6). 1,2-Dimethylnaphthalene was detected in SS-LE-02 at a concentration of 0.15 $\mu g/g$. The pesticide compounds 1,1-dichloro-2,2-dis(p-chlorophenyl)ethane and 2,2-bis(p-chlorophenyl)-1,1-dichloroethene were detected in SS-LE-01 at concentrations of 0.19 $\mu g/g$ and 0.55 $\mu g/g$, respectively. Numerous SVOC unknowns were reported in both samples at relatively low concentrations, however, SVOC unknowns at similar concentrations were also detected in the laboratory method blank (see Subsection 3.2.3.4).

Specific analysis of the samples for PCBs was not performed. However, based on review of the analytical data for SVOC TICs, no PCBs were reported.

Mercury was detected in SS-LE-02 at a concentration of 0.261 $\mu g/g$. Lead was also detected in SS-LE-02 at a concentration of 1,300 $\mu g/g$, compared to a concentration of 79 $\mu g/g$ detected in SS-LE-01. Other inorganic analytes detected in the sample are presented in Table 9-2.

9.5 Source Evaluation and Migration Potential

Assessment of the analytical data indicates that lead, mercury and a heavy molecular weight oil or lubricating fluid were detected in SS-LE-02. While the presence of heavy molecular weight oil or lubricating fluids is consistent with transformers, the presence of mercury is not. There is potential for these compounds to migrate vertically through the soil column to the water table. The presence of pesticides is not unexpected in a transformer area. Low concentrations of pesticides can also be attributable to routine usage by Fort Allen personnel in the cantonment area. SVOC unknowns detected in the sample are likely not representative of site conditions as they were detected in the laboratory method blank.

9.6 Conclusions and Recommendations

Based on the results and findings mentioned above, a potential source area was identified at the transformer site. Lead, mercury and heavy hydrocarbons detected in SS-LE-02 indicate the presence of a potential source area. Mercury was detected in one of two samples. The extent of its presence should be confirmed prior to considering the result to be indicative of a source of contamination.

Additional subsurface soil sampling for VOCs and pesticides/PCBs is recommended to better define the nature and extent of contamination for this site. In addition, samples should be collected to confirm the presence or absence of VOCs. Confirmation of the presence and extent of mercury should also be included in subsequent investigations.

10.0 UNDERGROUND STORAGE TANKS (USTs)

As presented in the PA Report (Weston, 1994), available records indicate that four USTs were originally located in the cantonment area of Fort Allen. Two of the USTs have been abandoned in place and are located at former Gas Station No. 2 on the western edge of the cantonment area, just east of the Paint and Chemical Storage Room, Building 358. Another UST is located at Gas Station No. 1, at the entrance to OMS #9. At the time of the Phase I SI field program, the gas station appeared to be inoperative; the status of the UST is unknown. The fourth UST identified in the PA Report is located at Building 222 in the north-central portion of the cantonment area. This UST reportedly has a 25,000-gallon capacity and is used to store diesel fuel (Weston, 1994). The PA Report also indicates that a similar 25,000 gallon capacity abandoned UST is located at OMS#9, but site personnel were not able to confirm this (Weston, 1994).

During the Phase I SI investigation in November of 1996, it was observed that four monitoring wells had been recently installed in the vicinity of a (removed) UST on the east side of Building 358, the Paint and Chemical Storage Room (see Section 7.0). This work had been performed by the PRARNG. As indicated in Section 1.0, the USTs at Fort Allen are under investigation by the PRARNG under the direction of the PREQB. Therefore, no investigation activities were conducted regarding USTs as part of the Phase I SI.

11.0 ABOVEGROUND STORAGE TANKS (ASTs)

As presented in the PA Report (Weston, 1994), interviews with Fort Allen site personnel were unable to confirm the number, locations, and historical background of ASTs at Fort Allen. AST records that were available for review during the PA in 1993 were incomplete (Weston, 1994). There are reported to be eight abandoned ASTs located throughout Fort Allen. Fort Allen site personnel report that the ASTs were emptied upon abandonment (Weston, 1994).

As indicated in Section 1.0, the ASTs at Fort Allen are under investigation by the PRARNG under the direction of the PREQB. Therefore, no investigation activities were conducted regarding ASTs as part of the Phase I SI.

12.0 WASTEWATER TREATMENT PLANT

The WWTP has a history of failures in complying with the discharge limits set forth in the NPDES permit (Weston, 1994). The documented inefficiency of treatment and poor physical condition of the Fort Allen's WWTP are the cause of concern over a former or potential release. The historically poor condition of the wastewater treatment system and confirmation of NPDES permit violations make this system a potential conduit for any type of liquid product that may have been discharged directly to the sanitary sewer on Fort Allen (Weston, 1994). The following subsections present the findings of the Phase I SI conducted at the WWTP during November-December 1996 field program.

12.1 STUDY AREA BACKGROUND AND CONDITIONS

The WWTP is located on the eastern boundary of Fort Allen property near the intersection of the two runways (see Figures 1-3 and 12-1). Based on available information, the WWTP has been permitted to discharge into an open ditch, that eventually reaches the Caribbean Sea (Weston, 1994). A 1984 study of the WWTP revealed that the system was in a state of disrepair (AEHA, 1984). The collection system was found to have significant infiltration/inflow during wet weather, and tree roots were also known to have entered joints and clogged pipes (Weston, 1994). The treatment plant itself was not operating efficiently and was found to be in need of significant upgrade and repair, as discharge limits were reportedly exceeded for several parameters, including oil and grease.

The WWTP covers an area of approximately one acre near the eastern property line of Fort Allen (see Figure 12-1). The property is generally flat with a gentle slope towards the southeast part of the site where a culvert diverts surface water runoff from a grassy drainage swale under the service road into an open concrete drainage channel. The service road runs north-south along the eastern boundary fenceline, from the Fort Allen gate at Route 149 to the WWTP. An office building is located on the northern part of the site. A fence surrounds the clarifier, and an earthen berm surrounds the entire site. Sludge drying beds are located west of the clarifier. A buried pipe connected to the clarifier transports treated water south towards the Fort Allen gate at Route 149, where it is discharged into an open concrete drainage channel.

Conversations with Fort Allen WWTP personnel revealed that the earthern berms surrounding the clarifier were constructed sometime after the 1984 study to prevent treatment plant overflow during heavy precipitation events. Prior to 1984, overflow from the clarifiers would reportedly discharge to the ground surface and drain overland towards the southeast, and into the drainage swale.

12.2 SITE INSPECTION PROGRAM SUMMARY

The SI at the Fort Allen WWTP was completed in December 1996, in accordance with the provisions of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program completed at the WWTP was designed to evaluate the presence or absence of contaminants associated with historic discharges as a results of treatment plant overflow during heavy precipitation events. Table 12-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of the collection of one surface soil sample, six subsurface soil samples, and installation and recovery of three soil vapor probes. The SI investigations focused on the south and southeastern parts of the site, where overflow discharges from the WWTP reportedly occurred.

One surface soil sample (SS-WW-01) was collected in the drainage swale on the southeastern part of the site (see Figure 12-2). The sample was submitted for off-site laboratory analysis by USAEC-approved methods for SVOCs, GRO, DRO, and inorganics.

A Geoprobe® was used to collect subsurface soil samples at six separate locations (GP-WW-01 through GP-WW-06) in the area where the buried pipe connects to the clarifier, and in the southeastern corner side of the site, where a drainage swale collects surface water runoff (see Figure 12-2). A summary of GeoProbe® borings made at the WWTP is presented as Table 12-2. Subsurface soil samples were collected from ground surface to 10 feet bgs. These soil samples were collected to evaluate potential contamination associated with the WWTP overflow discharges, and any discharges from the clarifier and connected discharge pipe. Subsurface soil samples were submitted for off-site laboratory USEPA Level II analyses of VOCs and oil and grease. The GeoProbe® data records are presented in Appendix A.

Three soil vapor probes (SV-WW-01 through SV-WW-03) were installed at the WWTP (see Figure 12-2). The soil vapor probes were placed in areas where effluent discharges reportedly occurred. The soil vapor probes were left in the ground for 17 days, recovered, and shipped to an off-site laboratory for analysis of VOCs and SVOCs by GC/MS.

12.3 Field Investigation Results and Observations

The subsurface soils encountered beneath the WWTP are characterized by a black organic clay with high plasticity near the surface, and brown clayey silts and silty clay with depth. GeoProbe® subsurface soil samples were screened with a PID and were below detectable limits (less than one ppm) (see Table 12-2). No visual evidence of contamination was observed in subsurface soil samples collected at the WWTP. Depth to groundwater or direction and rate of groundwater flow were not investigated during this Phase I SI. However, evaluation of information obtained from groundwater monitoring wells installed at other sites indicates that depth to water is approximately 12 to 15 feet bgs. Groundwater flow direction would appear to be to the south-southeast beneath the site (see Figures 2-2 and 3-1).

12.4 Nature and Distribution of Contamination

The objective of the sampling program at the Fort Allen WWTP was to investigate the presence or absence of contamination caused by overflow discharges and historical operations of the WWTP. The primary concern at the WWTP is that potential contaminants from the overflow of untreated wastewater may be impacting the soil and groundwater quality in the vicinity of the WWTP. In considering the potential contaminant migration pathways, one surface soil sample, six subsurface soil samples, and three soil vapor samples were collected.

12.4.1 Surface Soil

Off-site analytical results from surface soil sample SS-WW-01, collected in the drainage swale southeast of the WWTP (see Figure 12-2), did not detect the presence of any site-related compounds (Table 12-3). DRO was reported at a concentration of 16 μg/g. This result may be indicative of traces of a highly weathered hydrocarbon with a heavier molecular weight than diesel (see Subsection 3.2.3.6).

Numerous SVOC unknowns were reported in the sample, however, SVOC unknowns at comparable concentrations were also detected in the laboratory method blank (see Section 3.2.3.4). Therefore, the SVOC unknowns in this sample are not considered to be site-related contaminants. Lead was detected in the sample at a concentration of 22.6 $\mu g/g$. Other inorganic analytes detected in the sample are presented in Table 12-3. None of the inorganic analytes detected are considered to be site-related contaminants.

12.4.2 Subsurface Soil

USEPA Level II VOC and oil and grease analytical results for subsurface soil samples collected by the GeoProbe® at the WWTP are presented in Table 12-4. VOCs and oil and grease were not detected above the quantitation limits in any of the subsurface soil samples.

12.4.3 Soil Vapor Survey

As indicated in Section 3.2, soil vapor survey analytical results were blank-corrected prior to assessment of soil vapor contamination. Soil vapor survey analytical results are presented in Appendix C. Analytical results from the three soil vapor probes (SV-WW-01 through SV-WW-03) include the positive detection of chloroform. Chloroform was not detected in the trip or method blanks. Results for all other analytes were below the MDL.

12.5 Source Evaluation and Migration Potential

Analytical results from subsurface soils at the WWTP do not indicate the presence of a subsurface contamination source area at the exploration locations. Chloroform was detected in the three soil vapor probes, however, these detections could not be attributed to a specific source area based on site activities. As no source areas were identified in the soil sample analyses at the WWTP, migration of contaminants was not been addressed.

12.6 CONCLUSIONS AND RECOMMENDATIONS

The primary concern at the WWTP is the potential contamination of subsurface soil and groundwater associated with historic overflow of untreated wastewater and the historically poor condition of the physical plant. Phase I SI investigations of surface and subsurface soils and soil vapor did not identify the presence of any contaminant source areas at the WWTP. However, soil vapor survey results reported chloroform present in the soil vapor beneath the site, but a likely source was not identified.

Based on the results and findings mentioned above, it is recommended that no further action be undertaken at the WWTP.

13.0 AREA OF CONCERN 3

AOC 3 is located west of the U.S. Navy Radio Station, near the western boundary of Fort Allen, (Figure 1-2). AOC 3 includes a RCRA landfill and two prominent trench features noted on the 1962, 1963 and 1967 aerial photographs (USARTAC, 1996b). The following subsections present the findings of the SI conducted at AOC 3 during the November - December 1996 field program.

13.1 STUDY AREA BACKGROUND AND CONDITIONS

AOC 3 includes the RCRA landfill (USARTAC, 1996a). No information is available regarding the time that the RCRA landfill was operated or the type(s) and quantities of materials disposed at the site. According to Fort allen personnel, the landfill has been closed under RCRA, but no records of the closure, or a Part B permit, could be found (USAEC, 1996). It appears that the landfill was covered when filling operation ceased, sometime after 1987 (USARTAC, 1996b). Currently, the only evidence of a landfill is a fence that surrounds the site. The area inside the fence is now overgrown with Guinea Grass (Panicum maximum), and small trees such as Zarcilla (Leucaena glauca), Bayahonda (Prosopis juliflora) and Palo de Rayo (Parkinsonia aculeata) (USARTAC, 1996a).

Several prominent trench features have been identified to the south and southeast of the landfill in the 1962, 1963, and 1967 aerial photographs (Figure 13-1). The presence of the most northern trench feature, identified in the 1967 aerial photograph, was confirmed by electromagnetic and magnetic geophysical surveys (USACE, 1996) and visual observations made during the SI field program in November 1996. The geophysical surveys identified buried debris southeast of the RCRA landfill. A geophysical anomaly map of the area southeast of the RCRA landfill is presented as Figure 13-2. A trench feature was also identified approximately 200 meters south of the RCRA landfill in 1962, 1963 and 1967 aerial photographs (USARTAC, 1996b). No information is available regarding the past use or potential contents of this trench. The trench features were located and flagged using GPS during the USARTAC Site Investigation completed in July 1996.

An old irrigation canal (cement aqueduct as described in the Site Investigation Report, May, 1996), which runs north-south across the northern part of Fort Allen,

is shown on the Poncé, Puerto Rico U.S. Geological Survey (USGS) topographic map. This drainage canal was used to divert water for irrigation of the sugarcane prior to the development of Fort Allen. This former drainage canal, which is no longer in use, borders the northern part of AOC 3 (USARTAC, 1996a).

AOC 3 is located approximately 1.5 kilometers south of the Jacaguas River. It does not appear that there are any surface water pathways from AOC 3 to the Jacaguas River.

AOC 3 surface water runoff appears to drain to the south, following the topography and/or infiltrating the ground surface of AOC 3.

13.2 Site Inspection Program Summary

The SI at AOC 3 was completed in December 1996, and was conducted in accordance with the provisions of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program conducted at AOC 3 was designed to evaluate the presence or absence of contaminants associated with the two trenches and RCRA landfill discussed in Section 13.1 above. Table 13-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of the collection of ten subsurface soil samples, the installation of two groundwater monitoring wells downgradient of the two identified trenches and the RCRA landfill and the collection of groundwater samples from monitoring wells. The location of the northern trench was identified using GPS, historical aerial photographs (1962, 1963 and 1967), and field observations of a topographic depression. The presence of rusted cans and glass bottles confirmed the location of the southern trench. The areal extent of the RCRA landfill was identified from visible observations of the fence surrounding the site.

A GeoProbe® was utilized to collect subsurface soil samples at ten separate locations (GP-03-01 through GP-03-10) along the southern boundaries of the two trenches identified within AOC 3 (see Figure 13-3). A summary of GeoProbe® borings drilled at AOC 3 is presented as Table 13-2. Analytical soil samples were collected from 6 to 10 feet bgs from each boring to evaluate potential contamination associated with the trenches. Samples were submitted for off-site laboratory USEPA Level II

analyses of VOCs, and oil and grease (see Table 13-2). The GeoProbe® data records are presented in Appendix A.

In order to evaluate groundwater quality at AOC 3, two groundwater monitoring wells (MW-03-01 and MW-03-02) were installed downgradient from the two trenches and the RCRA landfill (see Figure 13-3). Table 13-3 summarizes the well completion details and Appendix D contains the monitoring well completion diagrams.

One round of groundwater samples was collected from monitoring wells MW-03-01 and MW-03-02 in December, 1996. Samples were submitted for off-site laboratory chemical analysis of VOCs, SVOCs, GRO, DRO, and inorganics.

13.3 Field Investigation Results and Observations

The surficial and bedrock geology of Fort Allen, in which AOC 3 is located, is discussed in Section 2.2.6 of this report. The Fort Allen area is blanketed by unconsolidated alluvium deposits of volcanic and limestone origin. During the SI field program, bedrock was not encountered at AOC 3, but the Poncé limestone has been mapped to the west of Fort Allen near the town of Poncé (Bogart et al., 1964). Subsurface explorations of the Phase I SI at AOC 3 were limited to the surficial geology of the alluvium deposits.

The subsurface unconsolidated deposits encountered during installation of groundwater monitoring wells MW-03-01 and MW-03-02 consisted of clayey silts and silty clay with interbedded, discontinuous sand and gravel lenses at various depths. When wet, the clayey silts and silty clay are highly plastic. Variable amounts of silts and clays are present in the samples obtained. The sand and gravel lenses are characterized by poorly sorted, fine to medium sands, and angular gravel, ranging in size from 1/4-to 1/2-inch in diameter; however, gravel with larger diameter was found in some of the split-spoon samples. The sand and gravel appear to be alluvium of volcanic origin, and appear to yield most of the groundwater from the soils beneath AOC 3. In general, the amounts of sand and gravel increase with depth at AOC 3. The unconsolidated deposits encountered during this investigation appear to be native to this part of Fort Allen. The boring logs for monitoring wells MW-03-01 and MW-03-02 are included in Appendix B. Appendix A contains the

GeoProbe® data records, which describe the soil samples encountered from 0 to 10 feet bgs at AOC 3.

A water-level survey of all the groundwater monitoring wells installed during this SI (MW-03-01, MW-03-02, MW-08-01 and MW-09-01) was conducted on December 3, 1996. Table 3-1 presents the groundwater elevations computed from the survey. Depths to the water table at AOC 3 range from 25 to 30 feet (7.6 to 9.2 meters) bgs. Based on the water level data collected, it appears that groundwater beneath AOC 3 flows towards the south-southeast and eventually discharges into the Caribbean Sea (see Figure 3-1). The estimated horizontal hydraulic gradient of the water table is 0.003 feet/foot (see Figure 3-1). A discussion of the hydrogeology of the Fort Allen area is presented in Subsection 2.2.7.

13.4 Nature and Distribution of Contaminants

The objective of the sampling program at AOC 3 was to investigate the presence or absence of contamination caused by any buried debris in the trenches to the south and southeast of the RCRA landfill. The primary concern at AOC 3 is that contaminants generated from the landfilled waste material may be impacting the quality of the soil and groundwater in the vicinity of AOC 3. In considering the potential contaminant migration pathways, it was determined that the most likely pathway for contaminant migration would be infiltration through the subsurface soil to groundwater. Subsurface soil samples were collected for analysis from exploration locations downgradient of the suspected trenches at a depth of 6 to 10 feet bgs to evaluate potential leaching of contaminants (see Figure 13-3). One round of groundwater samples was collected from the two monitoring wells located downgradient from suspected waste sources.

13.4.1 Subsurface Soil

USEPA Level II analytical results for subsurface soil samples collected during the SI for AOC 3 are presented in Table 13-4. VOCs were not detected above the quantitation limit in any of the subsurface soil samples. Oil and grease was not detected in any of the subsurface soil samples collected from AOC 3. Results of field screening of subsurface soil samples (depth interval 0 to 10 feet bgs) with a PID were also negative (see Table 13-2).

13.4.2 Groundwater

The laboratory analytical results for the groundwater samples collected from monitoring wells MW-03-01 and MW-03-02 are presented in Table 13-5.

Results indicate detection of acetone (5.4 μg/L) in MW-03-01, and DRO (250 μg/L) in MW-03-02. Although acetone was detected in the sample, and not in any of the associated blanks, this VOC is a common laboratory contaminant. Therefore, the acetone detected in the sample is not likely representative of site conditions. Review of the DRO chromatogram for MW-03-02 reveals peaks which may be representative fuel components. SVOC unknowns were detected in the MW-03-02 sample (61 μg/L total). However, it is unlikely that these are site-related due to detection of SVOC unknowns in the laboratory method blank (see Subsection 3.2.3.4).

Metals detected in the two groundwater samples include the naturally occurring elements aluminum, magnesium, sodium, calcium, iron, and zinc. Concentrations of aluminum (6,290 μg/L), iron (7,070 μg/L), and manganese (183 μg/L) in MW-03-02 exceed federal secondary drinking water standards (see Subsection 3.4). Concentrations of the inorganics in the thousands of μg/L in these samples are likely attributable to the turbidity of the samples (see Appendix F). Calcium and magnesium concentrations likely reflect the chemistry of the limestone-derived overburden in which the monitoring wells are screened.

13.5 Source Evaluation and Migration Potential

Investigations of shallow subsurface soil and groundwater did not reveal any potential contamination sources, and thus no potential for migration of contaminants.

13.6 Conclusion and Recommendations

The primary concern at AOC 3 is the possible contamination of subsurface soil and groundwater from potential historic disposal activities in the two trenches and the RCRA landfill. No contamination was detected in shallow subsurface soils adjacent to the two trenches. DRO detected in groundwater at MW-03-02 may be indicative of the presence of dissolved fuel components. Unknowns in the SVOC range detected in the MW-03-02 sample are not considered to be site-related.

Based on the results and findings mentioned above, it is recommended that additional groundwater quality evaluations be made within AOC 3 to assess potential impacts from disposal activities at the RCRA landfill. In addition, it is recommended that the RCRA Part B permit for landfill closure be obtained, if it exists. If the landfill was closed under RCRA guidelines, then monitoring wells would have been installed and sampled to evaluate groundwater quality. However, monitoring wells were not observed during the Phase I SI field investigation.

14.0 AREA OF CONCERN

AOC 8 is located on the northwest corner of the east-west runway (see Figures 1-1 and 14-1). AOC 8 was identified in a 1951 aerial photograph, and includes part of a fenced concrete area and two former structures located in the northern part of the study area (USARTAC, 1996a,b). The concrete area in AOC 8 is believed to have been used as a wash area for degreasing airplanes (USAEC, 1996), and as a storage area (USARTAC, 1996a). Currently, the site is not being used, however, the area to the east of this AOC is being used as a motor pool. No information or records exist on the activities performed, or the types or quantities of materials used at this AOC. The following subsections present the findings of the SI conducted at AOC 8 during the November-December 1996 field program.

14.1 STUDY AREA BACKGROUND AND CONDITIONS

AOC 8 includes part of a fenced area and two structures present in the 1951 aerial photograph (USARTAC, 1996b). No information other than the 1951 aerial photograph is available for the study area. The fenced area is approximately 80 meters wide by 120 meters long, and is made up of a concrete area on the southern side of the fenced area, and a vegetated soil area on the north. The extent of the concrete is delineated by a dashed line on Figure 14-1. The concrete slopes northward toward the vegetated soil area and the locations of the former structures located in the northern section of AOC 8 (see Figure 14-1). These structures were approximately 10 meters wide by 20 meters long; no information is available regarding the use of these buildings. Currently no building structures are present within the boundaries of the AOC.

AOC 8 is located approximately 1.5 kilometers east of the Jacaguas River. The SI did not identify any surface water pathways from AOC 8 to the Jacaguas River.

AOC 8 surface water runoff appears to drain to the north in the concrete area, and on the north part of AOC 8 it appears to infiltrate due to the flat topography. With the exception of the concrete area, AOC 8 is overgrown with Guinea Grass (Panicum maximum) (USARTAC, 1996a). A dirt road transects east-west through AOC 8, north of the fenced area. North of the dirt road is a tropical forest community which is densely vegetated (USARTAC, 1996a). Based on the available information,

historical activities may have potentially released contaminants related to past activities at the site.

14.2 Site Inspection Program Summary

The SI at AOC 8 was completed in December 1996, in accordance with the provisions of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program completed at AOC 8 was designed to evaluate the presence or absence of contaminants associated with operations discussed in Section 14.1 above. Table 14-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of the collection of two GeoProbe® subsurface soil samples, two soil borings, two soil vapor probes, the installation of one groundwater monitoring well, and the collection of a groundwater sample from the groundwater monitoring well. The aerial extent of AOC 8 was identified from the 1951 historical aerial photograph, and superimposed onto the current site plan (see Figure 14-1).

A GeoProbe® was utilized to collect subsurface soil samples at two exploration locations (GP-08-01 and GP-08-02). The explorations were installed adjacent to two PVC pipes discovered in cut-out holes in the concrete area; these pipes are believed to be drains. The GeoProbe® subsurface soil samples were collected from 6 to 10 feet bgs, to evaluate potential contamination associated with unknown past practices. Subsurface soil samples from each boring were submitted for offsite laboratory USEPA Level II analyses of VOCs, and oil and grease. A summary of GeoProbe® borings drilled at AOC 8 is presented as Table 14-2, and the data records are presented in Appendix A.

Two soil borings (SB-08-01 and SB-08-02) were drilled in the vegetated soil areas, north of the concrete pad (Figure 14-2). The borings were located in areas of bare soil, within the otherwise vegetated area. A summary of soil borings drilled at AOC 8 is presented as Table 14-3. The soil borings were used to characterize the soils below AOC 8 and to collect subsurface soil samples for off-site laboratory analysis. These soil samples were collected to evaluate potential contamination associated with former operations at AOC 8. One subsurface soil sample from each soil boring was submitted for off-site laboratory chemical analysis of SVOCs, DRO, GRO and inorganics. Soil boring logs are presented in Appendix B.

Two soil vapor probes (SV-08-01 and SV-08-02) were installed to the south of AOC 8 to evaluate soil vapors under the concrete area (see Figure 14-2). The soil vapor probes were placed is the same locations as GeoProbe® borings for GP-08-01 and GP-08-02, near the PVC pipes discovered during the SI field work. The soil vapor probes were left in the ground for 17 days, recovered, and shipped to an off-site laboratory for analysis of VOCs and SVOCs by GC/MS.

To evaluate groundwater quality at AOC 8, one groundwater monitoring well (MW-08-01) was installed in the southern part of AOC 8 (see Figure 14-2). Table 14-4 summarizes the well completion details. Appendix B contains the boring logs and Appendix D contains the monitoring well construction diagram for MW-08-01.

One round of groundwater samples was collected in December 1996 from monitoring well MW-08-01, and analyzed for VOCs, SVOCs, DRO, GRO, and inorganics.

14.3 Field Investigation Results and Observations

The subsurface unconsolidated deposits encountered during drilling of the soil borings and installation of groundwater monitoring well MW-08-01 consist of clayey silt, grading into a silty clay with interbedded, discontinuous sand and gravel lenses at depth. The sand and gravel lenses are characterized by poorly graded, fine to medium sands and angular gravel. The sand and gravel appear to be alluvium of limestone and volcanic origin. The boring log for monitoring well MW-08-01 is included in Appendix B.

Depth to the water table at AOC was found to be approximately 20 feet bgs on December 3, 1996 (see Table 3-1). Based on water level data collected during the Phase I SI, it appears the groundwater beneath AOC 8 flows towards the south-southeast (see Figure 3-1). The estimated horizontal gradient of the water table in the vicinity of AOC 8 is 0.003 feet/foot (see Figure 3-1).

14.4 Nature and Distribution of Contaminants

The sampling program at AOC 8 was designed to evaluate the presence or absence of contaminants in the environment as a result of unknown historic activities. The primary concern at AOC 8 is that contaminants generated from the waste material

and from accidental spills may be impacting the quality of the soil and groundwater in the vicinity of AOC 8. The most likely pathways for contaminant migration are the subsurface soil and groundwater. One groundwater sample was collected from a monitoring well located downgradient of AOC 8. Subsurface soil samples were collected for analysis to evaluate potential infiltration and leaching of contaminants (see Figure 14-2).

14.4.1 Soil Vapor Survey

As indicated in Section 3.2, soil vapor survey analytical results were blank-corrected prior to assessment of soil vapor contamination. Soil vapor survey analytical results are presented in Appendix C. Analytical results from the two soil vapor probes (SV-08-01 through SV-08-03) indicate all VOC and SVOC analytes were below MDLs.

14.4.2 Subsurface Soil

Results of subsurface soil analyses are presented in the following subsections. GeoProbe® sample analytical data is presented in Table 14-5, and analytes detected in soil borings SB-08-01 and SB-08-02 are presented in Table 14-6.

14.4.2.1 GeoProbe® Borings. USEPA Level II VOC and oil and grease analytical results for subsurface GeoProbe soil samples collected within the concrete pad at AOC 8 are presented in Table 14-5. VOCs and oil and grease were not detected above the quantitation limits in any of the subsurface soil samples.

14.4.2.2 Soil Borings. The analytical samples from soil borings SB-08-01 and SB-08-02 were collected from a depth of 10 to 12 feet bgs, in the southern portion of AOC 8 (see Figure 14-2). Analytical results for all SVOC target analytes, GRO, and DRO were below the off-site laboratory certified reporting limits (Table 14-6). SVOC unknowns were reported in the samples; however, these unknowns were also detected in the laboratory method blank (see Subsection 3.2.3.4), and therefore are not considered to be site-related. Inorganic analytes detected in the sample are presented in Table 14-6. Lead was detected in the samples from SB-08-01 (2.55 μg/g) and SB-08-02 (2.13 μg/g). Inorganic analyte concentrations are comparable to concentrations in other subsurface soil samples collected during the Phase I SI.

14.4.3 Groundwater

Analytes detected in the groundwater sample collected from groundwater monitoring well MW-08-01 are presented in Table 14-7.

No VOC target analytes, SVOC target analytes, GRO, or DRO were detected in the MW-08-01 sample. One SVOC unknown at 2 $\mu g/L$ was detected in the sample, and is not considered to be indicative of site-related contamination, as SVOC unknowns at similar concentrations were detected in the laboratory method blank (see Section 3.2.3.4). Inorganics detected in the sample are presented in Table 14-7. Aluminum, iron and manganese concentrations in the sample exceed Federal secondary drinking water standards, but are not considered to be site-related contaminants.

14.5 Source Evaluation and Migration Potential

Analytical results from soil vapor, subsurface soils and groundwater at AOC 8 do not indicate the presence of a subsurface contamination source area at the exploration locations. As no contaminant source areas were identified at AOC 8, the potential for migration of contaminants was not evaluated.

14.6 Conclusions and Recommendations

The primary concern at AOC 8 is the potential contamination of subsurface soil and groundwater by potential contaminants associated with historic activities. Evaluation of Phase I SI investigations of soil vapor, subsurface soils and groundwater indicates no contaminant source areas at AOC 8.

Sampling of groundwater to the southeast (downgradient) of the former structures identified in the 1951 aerial photograph is recommended to evaluate groundwater quality downgradient of these former structures.

15.0 AREA OF CONCERN 9

AOC 9 is located on the western end of the east-west runway, near the western boundary of Fort Allen (Figures 1-3 and 14-1). AOC 9 includes several groups of features present in the 1951 aerial photograph (see Figure 14-1). The following subsections present the findings of the Phase I SI conducted at AOC 9 during the November-December 1996 field program.

15.1 STUDY AREA BACKGROUND AND CONDITIONS

AOC 9 has five groups of features in the 1951 aerial photograph. These features includes (1) a light-toned area adjacent to a large mound on the southwest part of AOC 9, (2) another light-tone area located on the northwest part of AOC 9, (3) an area associated with three parallel linear features (suspected trenches) on the southeast corner of AOC 9, (4) a cluster of berms including a U-shape berm, a crescent-shape berm, and a square mound, all located on the northeast part of AOC 9 and (5) one light-toned area (possibly a dump site), located in the center of AOC 9 (see Figure 14-1). These areas appear cleared of vegetation in the 1951 aerial photograph. However, these areas are now fully vegetated. No information or records are available regarding the potential use or types and quantities of material disposed at these locations. This Phase I SI addressed these sites, with the exception of the cluster of berms and mounded material identified in the 1951 aerial photograph in the northeast corner of AOC 9.

In order to determine the location of the features of concern for AOC 9, USARTAC located and flagged the features using a GPS unit during a Site Investigation in May, 1996 (USARTAC, 1996a). Several dirt roads cut across AOC 9. One road on the southern boundary runs east-west from the cantonment area towards the western property fence (see Figure 14-1). A second road runs north-south along the eastern edge of AOC 9. A smaller road runs west from the north-south road and circles the light-toned area in the center of AOC 9 (see Figure 14-1).

AOC 9 is located approximately 1 kilometer east of the Jacaguas River. It does not appear that there are any surface water pathways from AOC 9 to the Jacaguas River. The surface water runoff appears to drain southeast, following the topography and/or infiltrating into the ground surface at AOC 9.

15.2 SITE INSPECTION PROGRAM SUMMARY

The Phase I SI at AOC 9 was completed in December 1996, and was conducted in accordance the provisions of the Fort Allen Technical Plan (ABB-ES, 1996a) and QAPjP (ABB-ES, 1996b). The field sampling program conducted at AOC 9 was designed to evaluate the presence or absence of contaminants associated with the group of features discussed in Section 15.1. Table 15-1 summarizes the technical approach and rationale for sample and exploration locations.

The field program consisted of the collection of eight subsurface soil samples using the GeoProbe®, four soil borings, collection of two surface soil samples, the installation of one groundwater monitoring well, and the collection of one groundwater sample from the groundwater monitoring well. The areal extent of AOC 9 and the locations of the historical features were obtained from the 1951 aerial photograph. During the Phase I SI field investigation, features were identified by visual inspection of the area and GPS survey.

A GeoProbe® was utilized to collect subsurface soil samples at eight locations around the light-toned feature located in the center of AOC 9 (GP-09-05 through GP-09-08) and around the three linear features in the southeast portion of the study area (GP-09-01 through GP-09-04) (see Figure 14-2). Some GeoProbe borings (GP-09-04, -06, and -07) were located outside the areas identified in the 1951 aerial photograph based on visual observations of partially buried refuse (rusted cans and glass) during the Phase I SI field program. A summary of explorations drilled at AOC 9 is presented as Table 15-2. Soil samples were collected from ground surface to 10 feet bgs to evaluate potential contamination associated with the light-toned area in the center of AOC 9 and the three parallel linear features in the southeastern corner of AOC 9. One subsurface soil sample from each boring was submitted for off-site laboratory USEPA Level II analyses of VOCs, and oil and grease (see Table 15-2), and data records are presented in Appendix A.

Four soil borings (SB-09-01 through SB-09-04) were drilled as part of the Phase I SI at AOC 9 (see Figure 14-2). A summary of soil borings drilled at AOC 9 is presented as Table 15-3. The soil borings were used to characterize the soils below AOC 9 and to obtain soil samples for off-site laboratory analysis for the purpose of evaluating potential contamination associated with the identified group of features. One subsurface soil sample from each soil boring was submitted for off-site

laboratory chemical analysis of SVOCs, GRO, DRO, and inorganics. Soil boring logs are presented in Appendix B.

To evaluate the groundwater quality at AOC 9, one groundwater monitoring well (MW-09-01) was installed in the southeast corner of AOC 9, downgradient from the three parallel linear features observed in the 1951 aerial photograph. Table 15-4 summarizes the well completion details, and Appendix D contains the monitoring well completion diagram.

One groundwater sample was collected from monitoring well MW-09-01. Groundwater sampling was conducted in December 1996, and the sample was analyzed for VOCs, SVOCs, DRO, GRO, and inorganics.

15.3 Field Investigation Results and Observations

The surficial and bedrock geology of Fort Allen has been discussed in Section 2.2.6 of this report. Bedrock was not encountered at AOC 9 during the SI field program. Subsurface explorations were limited to the surficial geology of the alluvial deposits.

The subsurface unconsolidated deposits encountered during drilling of the soil borings and installation of groundwater monitoring well MW-09-01 consist of clayey silts with interbedded, discontinuous sand and gravel lenses at depths. The clayey silts beneath AOC 9 were dark brown in color and plastic when wet. The sand and gravel lenses are poorly sorted, fine to medium sand with angular gravel ranging in size from 1/4- 1/2-inch diameter. As observed at AOCs 3 and 8, sand and gravel lenses appear to increase with depth.

A water level survey of all monitoring wells installed during this Phase I SI was conducted on December 3, 1996, prior to sampling of the groundwater monitoring wells. Table 3-1 presents the groundwater elevations computed from the survey. Depth to the water table at AOC 9 is approximately 13 feet bgs. Based on the water level data collected, it appears that groundwater beneath AOC 9 flows towards the south-southeast (see Figure 3-1). The estimated horizontal hydraulic gradient of the water table in the vicinity of AOC 9 is 0.003 feet/foot (see Figure 3-1).

15.4 NATURE AND DISTRIBUTION OF CONTAMINANTS

The objective of the sampling program at AOC 9 was to investigate the presence or absence of contamination caused by any potentially buried debris. The concern at AOC 9 is that contaminants generated from waste material may be impacting the quality of the soil and groundwater in the area. In considering the potential contaminant migration pathways, surface soil, subsurface soil and groundwater samples were collected to evaluate potential contamination.

15.4.1 Surface Soil

Analytical results from surface soil samples SS-09-01 and SS-09-02 (see Figure 14-2) indicate detection of SVOCs, DRO, and inorganics (Table 15-5). Numerous SVOC unknowns were reported in the samples, however, SVOC unknowns at similar concentrations were also detected in the laboratory method blank (see Subsection 3.2.3.4). Therefore, the SVOC unknowns in these samples are not considered to be site-related contaminants. The SVOC TICs octadecane and 2,4-bis(isopropylamino)-6-methoxy-1,3,5-triazine (trade name Pramitol or Prometon) were detected in SS-09-01 at concentrations of 0.21 $\mu g/g$ and 0.15 $\mu g/g$, respectively. 2,4-Bis(isopropylamino)-6-methoxy-1,3,5-triazine is a nonselective herbicide used to control broadleaf weeds and grasses. Herbicides have been used historically at Fort Allen (see Section 8.0). DRO was detected in SS-09-01 at a concentration of 18.6 $\mu g/g$, and in SS-09-02 at a concentration of 6.74 $\mu g/g$. Review of the DRO chromatogram for sample SS-09-01 indicates the DRO sample result may be indicative of traces of a highly weathered hydrocarbon with a heavier molecular weight than diesel. Lead was detected in samples SS-09-01 and SS-09-02 at concentrations of 32 $\mu g/g$ and 3.23 $\mu g/g$, respectively. Other inorganic analytes detected in the sample are presented in Table 12-4. None of the inorganic analytes detected are considered to be site-related contaminants.

15.4.2 Subsurface Soil

Results of subsurface soil off-site laboratory analyses are presented in the following subsections. Analytical data for GeoProbe® samples are presented in Table 15-6, and analytes detected in soil borings SB-09-01 through SB-09-04 are presented in Table 15-7.

15.4.2.1 GeoProbe® Borings. USEPA Level II VOC and oil and grease analytical results for subsurface GeoProbe soil samples collected at AOC 9 are presented in Table 15-6. VOCs and oil and grease were not detected above the quantitation limits in any of the subsurface soil samples.

15.4.2.2 Soil Borings. The analytical samples from soil borings SB-09-01 and SB-09-04 were collected from a depth of 10 to 12 feet bgs, within the four site features identified in Section 15.1 (see Figure 14-2). Analytes detected in these four samples are presented in Table 15-7. Bis(2-ethylhexyl)phthalate was detected in samples from SB-09-01 and SB-09-02. Although not detected in the rinse blanks or laboratory method blanks, bis(2-ethylhexyl)phthalate is a common laboratory contaminant (USEPA, 1994). Therefore, the detection of this compound does not necessarily indicate it is a site-related contaminant. 2,4-Bis(isopropylamino)-6-methoxy-1,3,5-triazine was detected in SB-09-01 (10 to 12 feet bgs) at a concentration of 0.32 μg/g. SVOC unknowns were reported in the samples; however, these unknowns were also detected in the laboratory method blanks (see Subsection 3.2.3.4), and therefore are unlikely to be site-related. DRO was detected only in the subsurface soil sample from boring SB-09-01, at a concentration of 6.71 μg/g. Inorganic analyte concentrations are comparable to concentrations in other subsurface soil samples collected during the Phase I SI.

15.4.3 Groundwater

Analytes detected in the groundwater sample collected from monitoring well MW-09-01 are presented in Table 15-8. No VOC target analytes, SVOC target analytes, GRO, or DRO were detected in MW-09-01. Inorganics detected in the groundwater sample were calcium (89,500 μg/L), magnesium (34,000 μg/L), and sodium (56,200 μg/L). None of these concentrations exceed federal MCLs or Puerto Rico groundwater quality standards.

15.5 SOURCE EVALUATION AND MIGRATION POTENTIAL

Analytical results from subsurface soils and groundwater at AOC 9 do not indicate the presence of any subsurface contamination source areas at the exploration locations in the four AOC 9 sites identified in Section 15.1. However, the herbicide 2,4-bis(isopropylamino)-6-methoxy-1,3,5-triazine (trade name Pramitol or Prometon) was detected in surface and subsurface soil samples (10 to 12 feet bgs). These

sample locations are located within the light-toned area in the southwest corner of AOC 9, which was identified in the 1951 aerial photograph. The detection of the herbicide in subsurface soils at a depth of 10 to 12 feet bgs indicates the potential for migration through the subsurface soils, and possibly to the water table.

15.6 CONCLUSIONS AND RECOMMENDATIONS

The primary concern at AOC 9 is the potential contamination of subsurface soil and groundwater by potential contaminants associated with historic activities. Phase I SI investigations of subsurface soils and groundwater do not indicate the presence of any contaminant source areas at AOC 9, with the possible exception of herbicide detection in the surface and subsurface soils of the light-toned area in the southwest corner of AOC 9 (see Figure 14-1).

Sampling and analysis of groundwater in the light-toned area in the southwest corner of AOC 9 is recommended to evaluate potential impact to groundwater from herbicides detected in the surface and subsurface soils of this area. In addition, it is recommended that subsurface soil and groundwater quality be evaluated for the cluster of berms identified in northeast corner of AOC 9. This cluster of berms was not investigated during the Phase I SI.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services Inc.
AEHA	U.S. Army Environmental Hygiene Agency
AOC	area of concern
APSPP	Accident Prevention Safety Program Plan
ARARs	Applicable and Relevant and Appropriate Requirements
AST	above ground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLP	contract laboratory program
COC	chain of custody
COR	Contracting Officer's Representative
DDT	dichlorodiphenyltrichloroethane (or 1,1,1-trichloro-2-2-bis-(p-chlorophenylethene
DQO	data quality objectives
DRO	diesel-range organics
ECAS	Environmental Compliance Assessment Report
ERNS	emergency response notification system
FID	flame ionization detector
GC/MS	gas chromatograph/mass spectrometer
GFAA	graphite furnace atomic absorption
GFD	Geotechnical Field Drilling
GGS	Geotechnical Groundwater Stabilized
GMA	Geotechnical Map
gpm	gallons per minute
GPS	global positioning system
GRO	gasoline-range organics
HSA	hollow-stem augers
ICP	inductively coupled plasma

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ICP/MS	inductively coupled plasma/mass spectrometry
ID	inside diameter
IDW	investigation derived waste
INS	Immigration and Naturalization Service
IRDMIS	Installation Restoration Data Management Information System
ISCP	Installation Spill Contingency Plan
LCL	lower control limit
LWL	lower warming limit
MCL	maximum contaminant levels
MDL	method detection limits
MOGAS	motor vehicle gasoline
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
NGB	National Guard Bureau
NPDES	National Pollutant Discharge System
OD	outside diameter
OMS #9	Organizational and Maintenance Shop #9
OSHA	Occupational Health and Safety Administration
PA	Preliminary Assessment
PARCC	precision, accuracy, representativeness, completeness, and comparability
PC	personal computer
PCBs	polychlorinated biphenyls
PCR	performance and cost report
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
PRARNG	Puerto Rico Army National Guard
PRC	Project Review Committee
PRE	preliminary risk evaluation
PREQB	Puerto Rico Environmental Quality Board
PRI	Potomac Research Institute
PVC	polyvinyl chloride

QA	quality assurance
QAC	quality assurance coordinator
QAPjP	Quality Assurance Project Plan
QC	quality control
RAS	routine analytical services
RCRA	Resource Conservation and Recovery Act
RDL	required detection limit
RPD	relative percent difference
ROTHER	over-the-horizon radar
SI	Site Inspection
SAS	special analytical services
SCS	Soil Conservation Service
SOP	standard operating procedure
SPCCP	Spill Prevention and Countermeasures Contingency Plan
TAL	target analyte list
TCL	target compound list
TIC	tentatively identified compound
TPH	total petroleum hydrocarbons
UCL	upper control limit
ug/g	microgram per gram
ug/kg	microgram per kilogram
ug/l	microgram per liter
URL	upper reporting level
UWL	upper warning limit
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USARTAC	U.S. Army Terrain Analysis Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compounds

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

WES	U.S. Army Corps of Engineers Waterways Experiment Station
WWTP	wastewater treatment plant

AEHA (U.S. Army Environmental Hygiene Agency). 1984. Potable/Recreational Water Quality Survey No. 31-24-0482-84, and Wastewater Engineering Survey No. 32-240478-84, Fort Allen, Juana Diaz, Puerto Rico.

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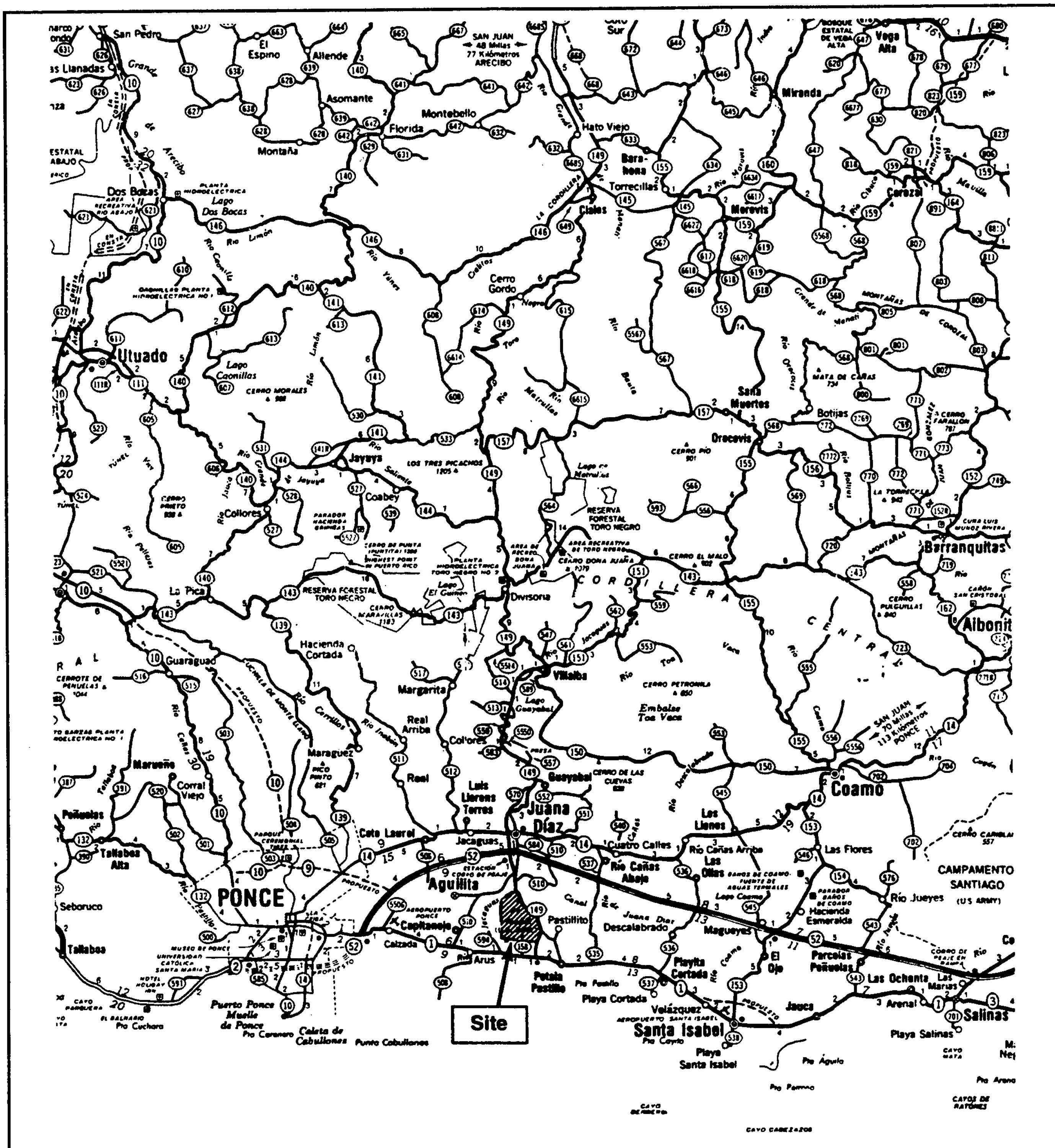
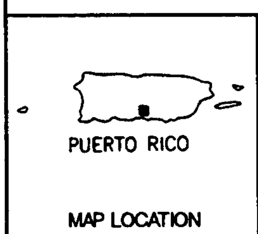


SOURCE: GOUSHA 1988 PUERTO RICO ROAD MAP



SCALE IN MILES

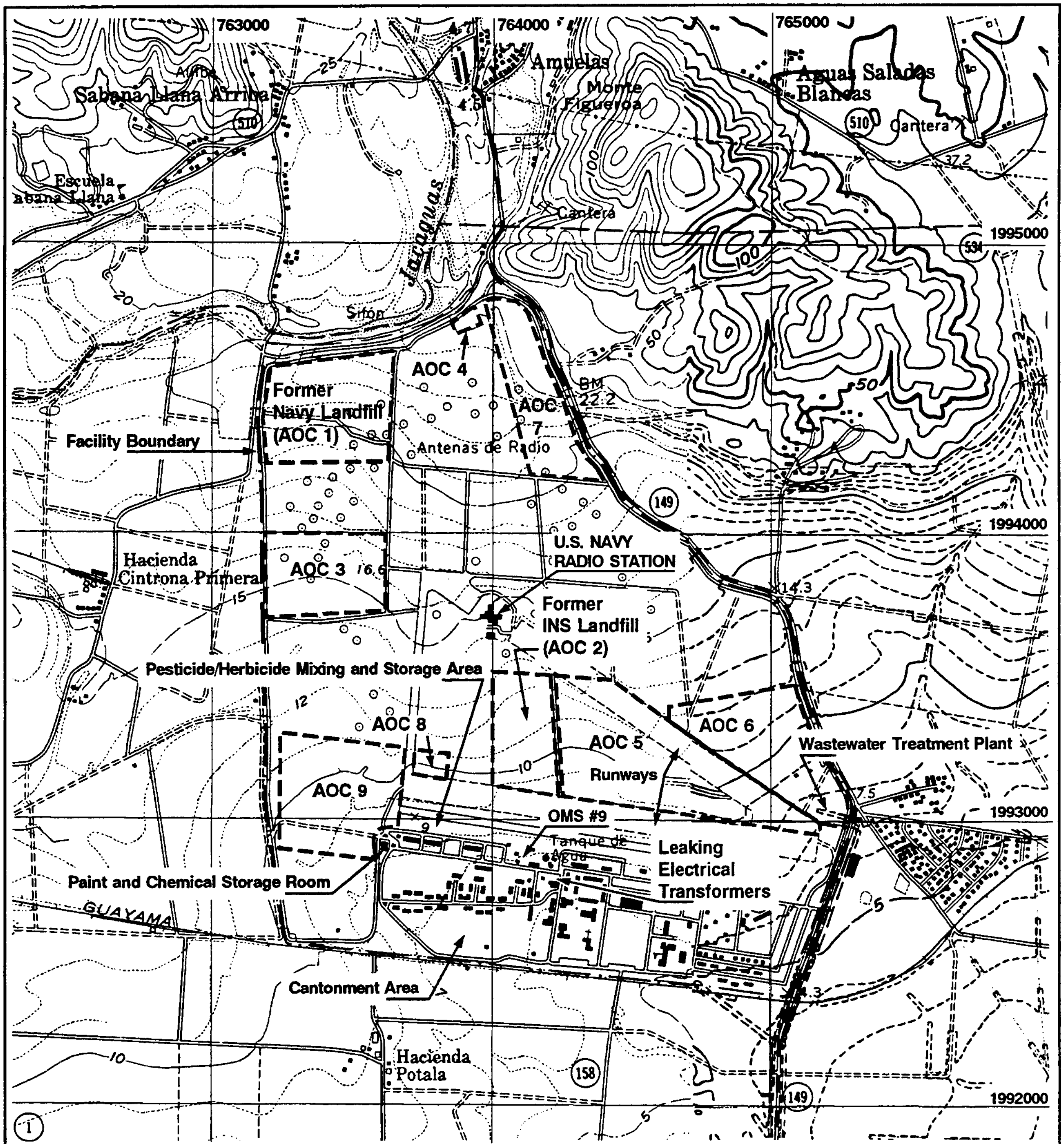
0 4 8

ONE INCH EQUALS APPROXIMATELY 4.5 MILES OR 7.3 KILOMETERS.

FIGURE 1-1
SITE LOCATION MAP
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D(a) C&P



NOTE: TOPOGRAPHIC CONTOURS ARE IN METERS ABOVE MEAN SEA LEVEL.

SOURCE: USGS TOPOGRAPHIC QUADRANGLES 7.5-MINUTE SERIES, PONCE AND RIO DESCALABRADO, PUERTO RICO. DATED 1970 AND 1972 (PHOTOREVISED 1982).

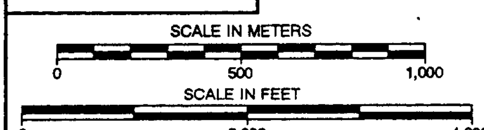
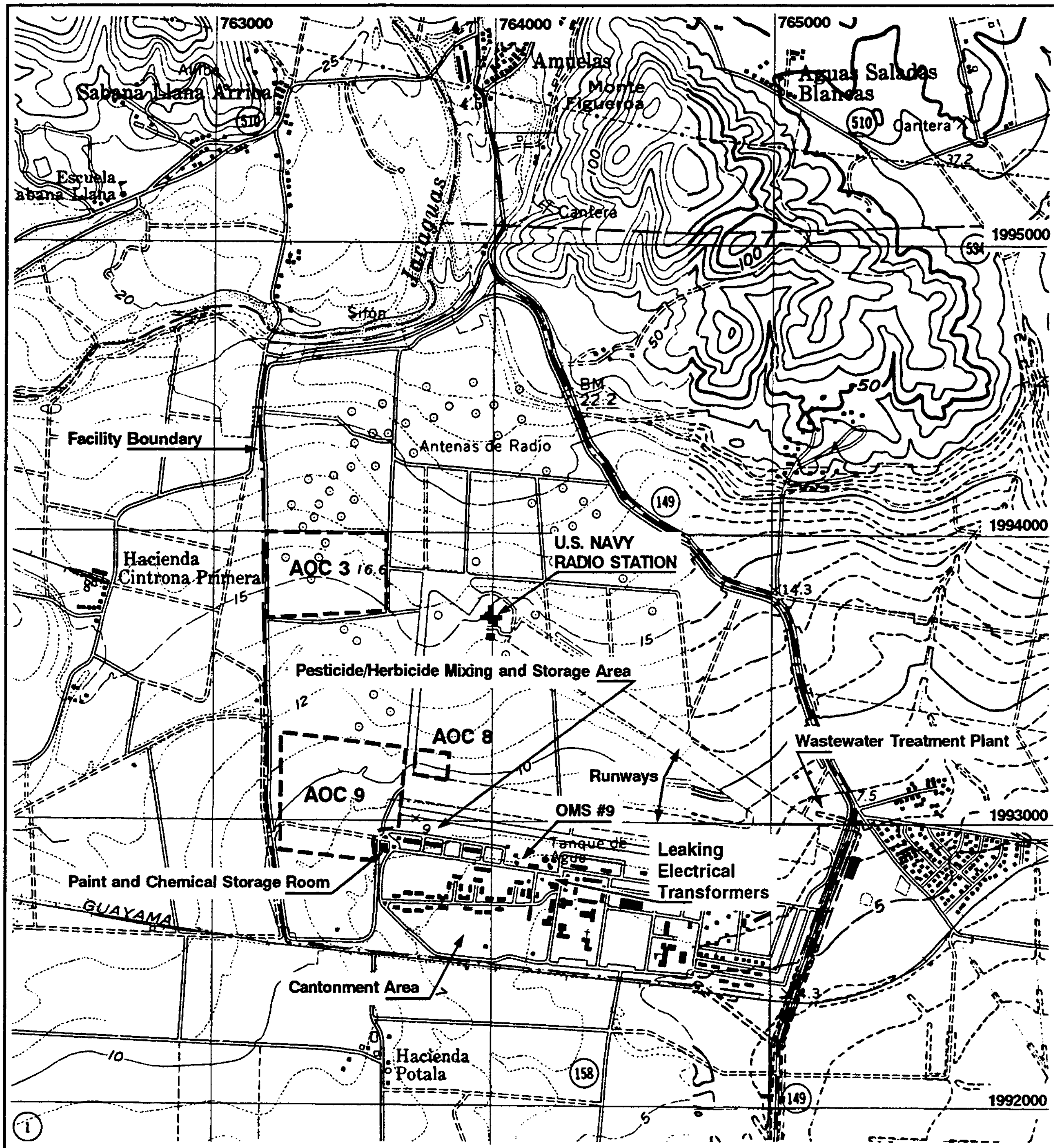


FIGURE 1-2
LOCATION OF PRELIMINARY ASSESSMENT SITES AND AOCs IDENTIFIED AT FORT ALLEN
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D(r)



NOTE: TOPOGRAPHIC CONTOURS ARE IN METERS ABOVE MEAN SEA LEVEL.

SOURCE: USGS TOPOGRAPHIC QUADRANGLE 7.5-MINUTE SERIES, PONCE AND RIO DESCALABRADO, PUERTO RICO. DATED 1970 AND 1972 (PHOTOREVISED 1982).

SCALE IN METERS: 0 — 500 — 1,000

SCALE IN FEET: 0 — 2,000 — 4,000

FIGURE 1-3
PHASE I SI AREAS OF INVESTIGATION
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D 2

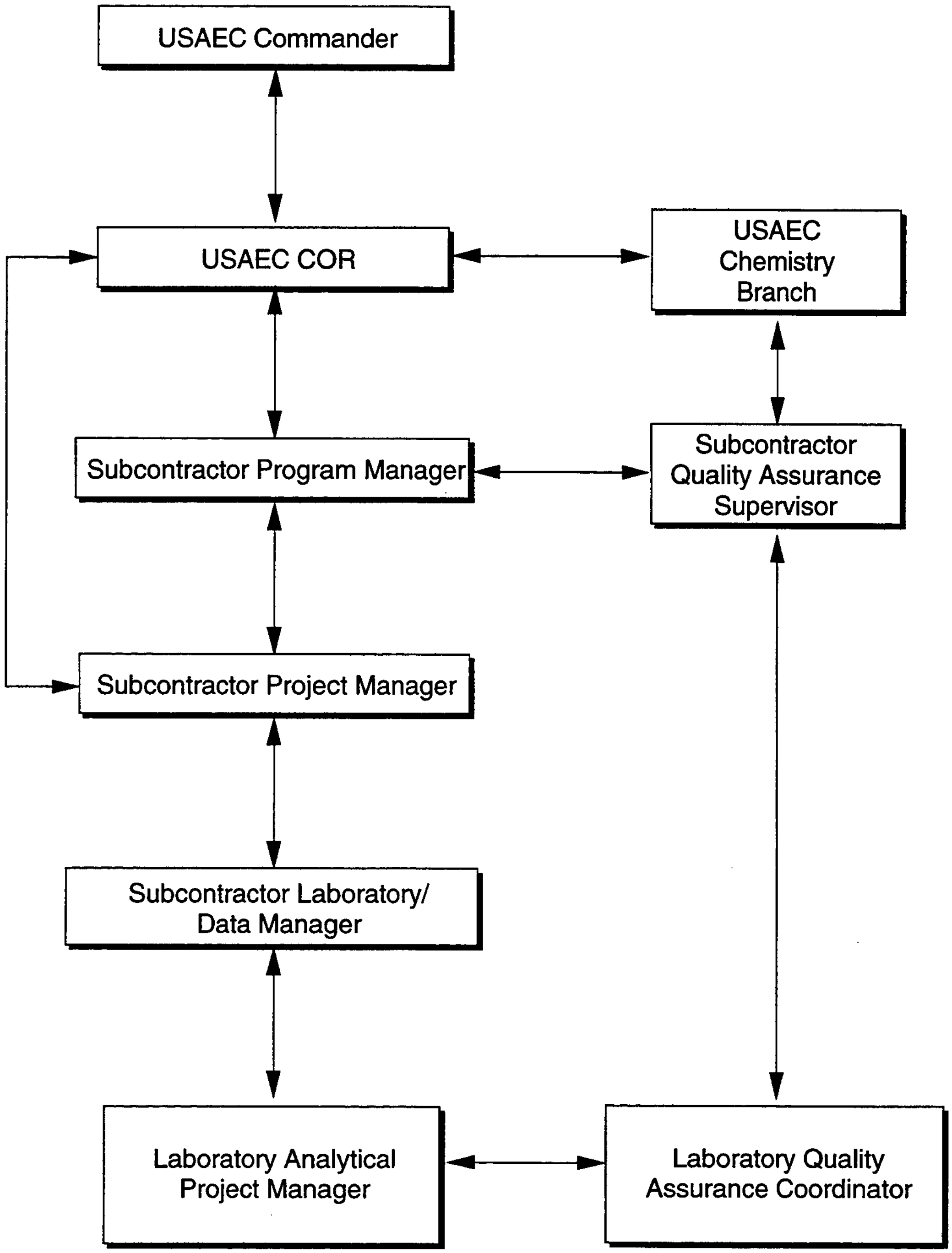
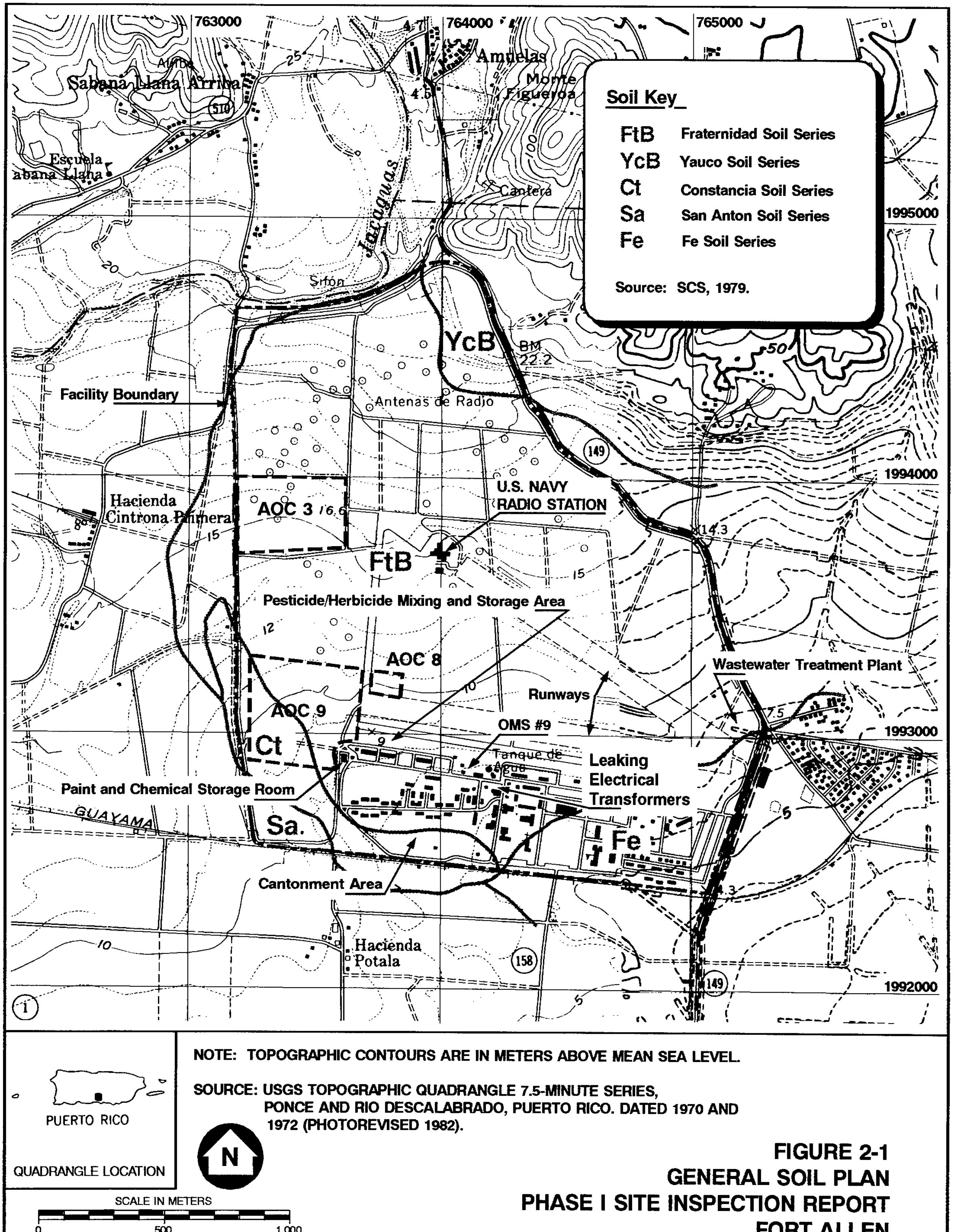


FIGURE 1-4
QA/QC FUNCTIONAL ORGANIZATION CHART
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

9610016D L15



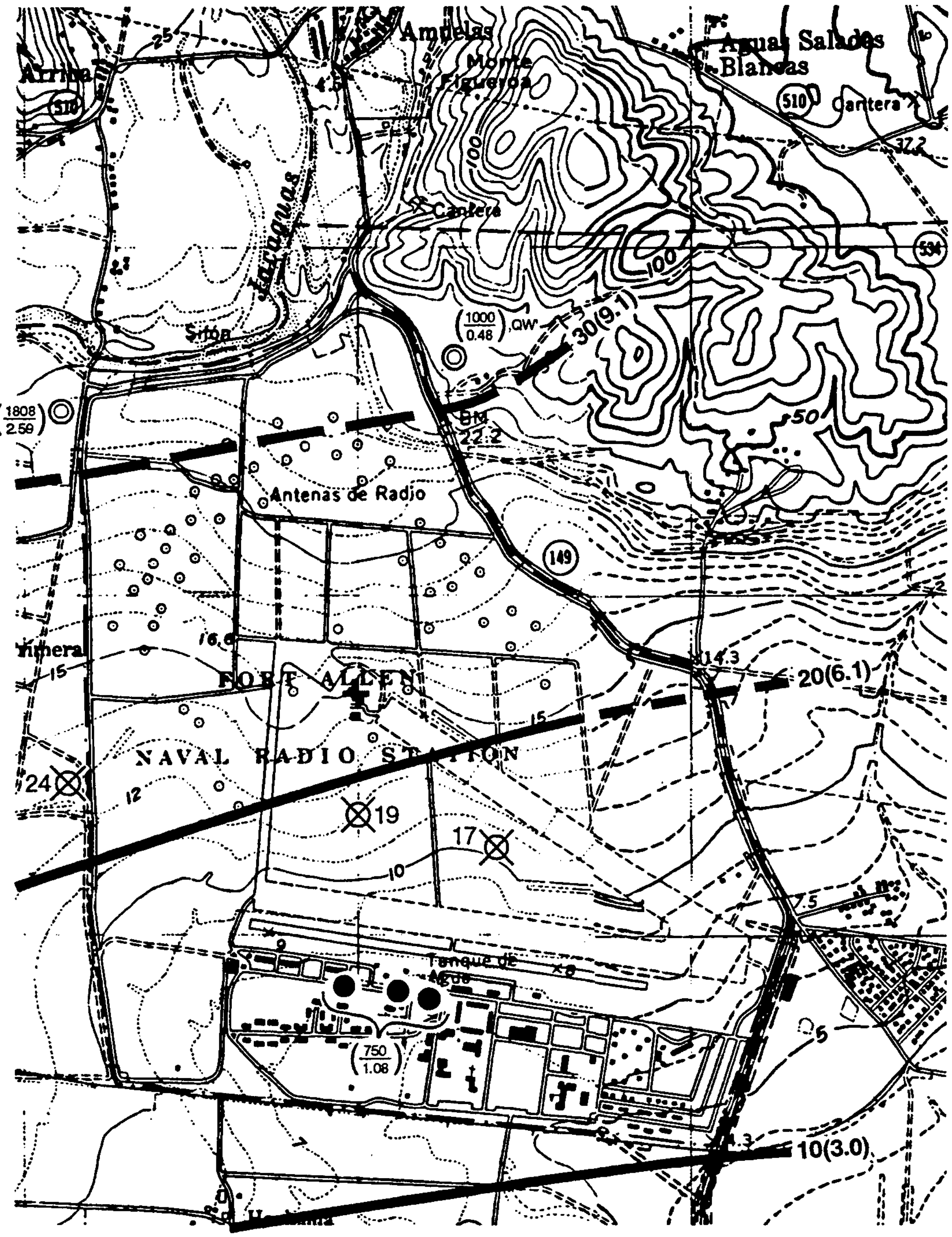
NOTE: TOPOGRAPHIC CONTOURS ARE IN METERS ABOVE MEAN SEA LEVEL.

SOURCE: USGS TOPOGRAPHIC QUADRANGLE 7.5-MINUTE SERIES, PONCE AND RIO DESCALABRADO, PUERTO RICO. DATED 1970 AND 1972 (PHOTOREVISED 1982).

FIGURE 2-1
GENERAL SOIL PLAN
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D(s) 2



NOTE:
TOPOGRAPHIC CONTOURS ARE IN METERS ABOVE MEAN SEA LEVEL.

MAP SOURCE:
USGS TOPOGRAPHIC QUADRANGLE 7.5-MINUTE SERIES, PONCE AND RIO DESCALABRADO, PUERTO RICO. DATED 1970 AND 1972 (PHOTOREVISED 1982).

LEGEND

- Irrigation Well
- Abandoned Well
- Domestic-Supply Well

20(1.6) **POTENTIOMETRIC CONTOUR** - shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Contour interval, in feet (metric equivalent within parenthesis) is variable. Datum is mean sea level.

-5R(750/1.08),QW **WATER-LEVEL AND PUMPAGE DATA** - Number preceding parenthesis is the altitude of water level in feet above mean sea level. Letter preceding parenthesis indicates water-level measurement made while well was pumping (P) or while water level was recovering (R) from pumping. Numbers in parenthesis are instantaneous well discharge in gallons per minute (upper number) and total daily pumpage in million gallons per day (lower number). Estimated values are identified with an "e". The letters QW indicate that a water sample was collected for analysis of common chemical constituents and stable isotopes of hydrogen and oxygen.

SOURCE: Fort Allen Site Investigation Report, U.S. Army Terrain Analysis Center, July 1996.

SCALE IN METERS
0 500 1,000
SCALE IN FEET
0 2,000 4,000

FIGURE 2-2
POTENTIOMETRIC SURFACE OF THE ALLUVIAL AQUIFER
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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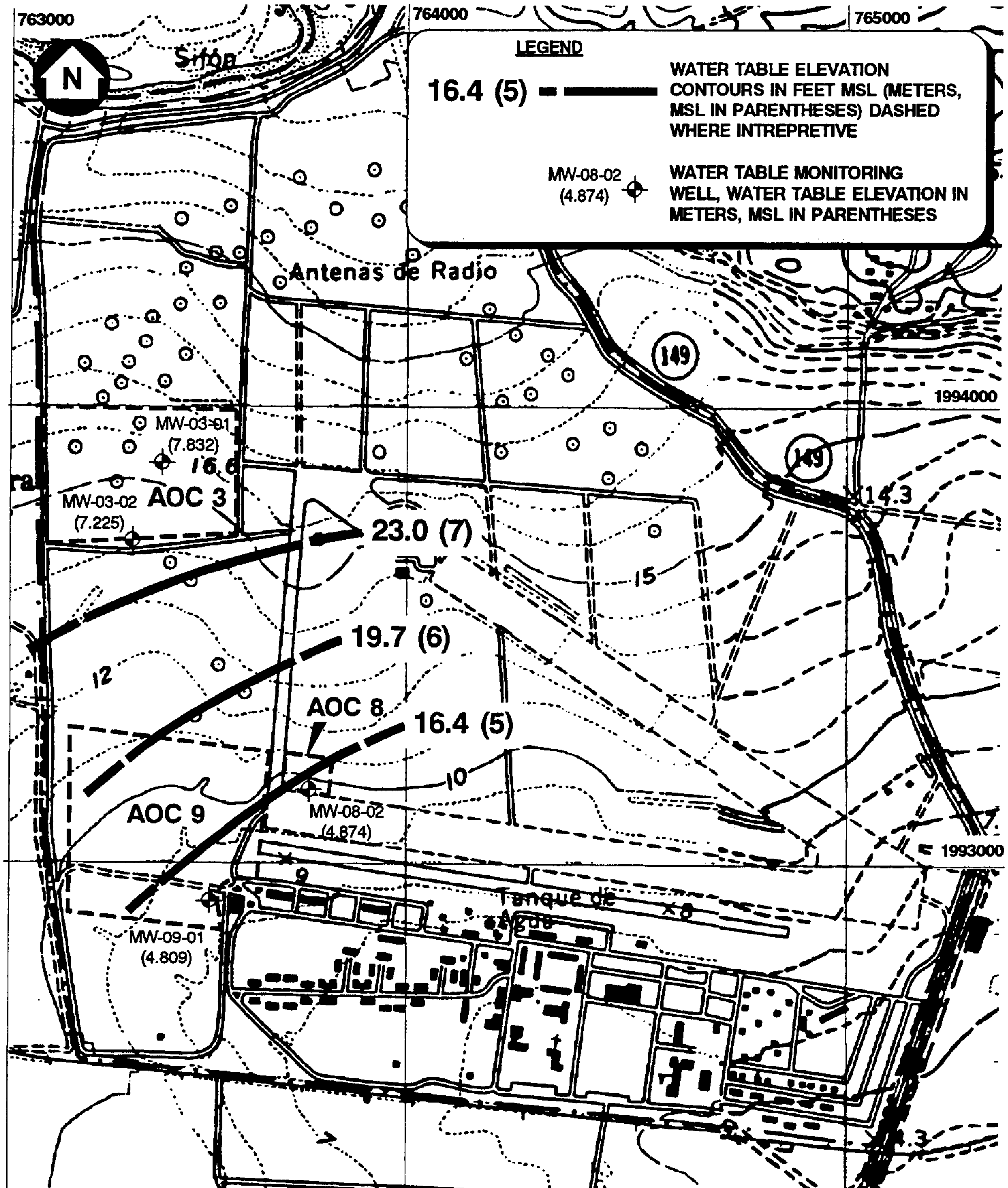


NOTE:
TOPOGRAPHIC CONTOURS ARE IN METERS ABOVE MEAN SEA LEVEL

SOURCE:
USGS TOPOGRAPHIC QUADRANGLE 7.5-MINUTE SERIES, PONCE, AND RIO DESCALABRADO, PUERTO RICO. DATED 1970 AND 1972 (PHOTOREVISED 1982).

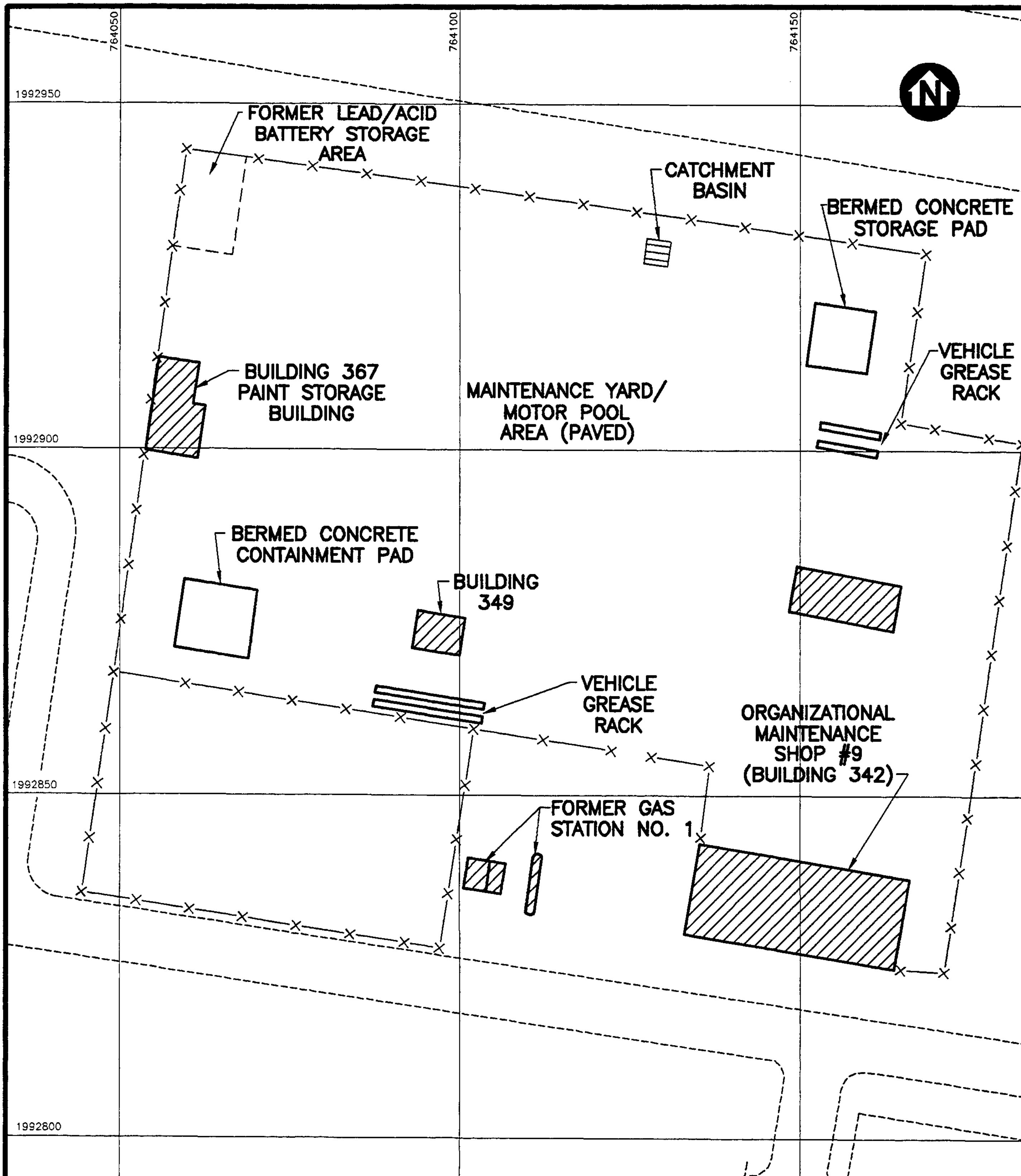
SCALE IN METERS
0 500 1,000

SCALE IN FEET
0 1,000 2,000

FIGURE 3-1
WATER TABLE ELEVATION CONTOUR PLAN
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D(p)



0 10 20 40 METERS

0 33 66 131 FEET

SCALE: 1"=20 METERS

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 6-1
OMS #9 SITE PLAN AND HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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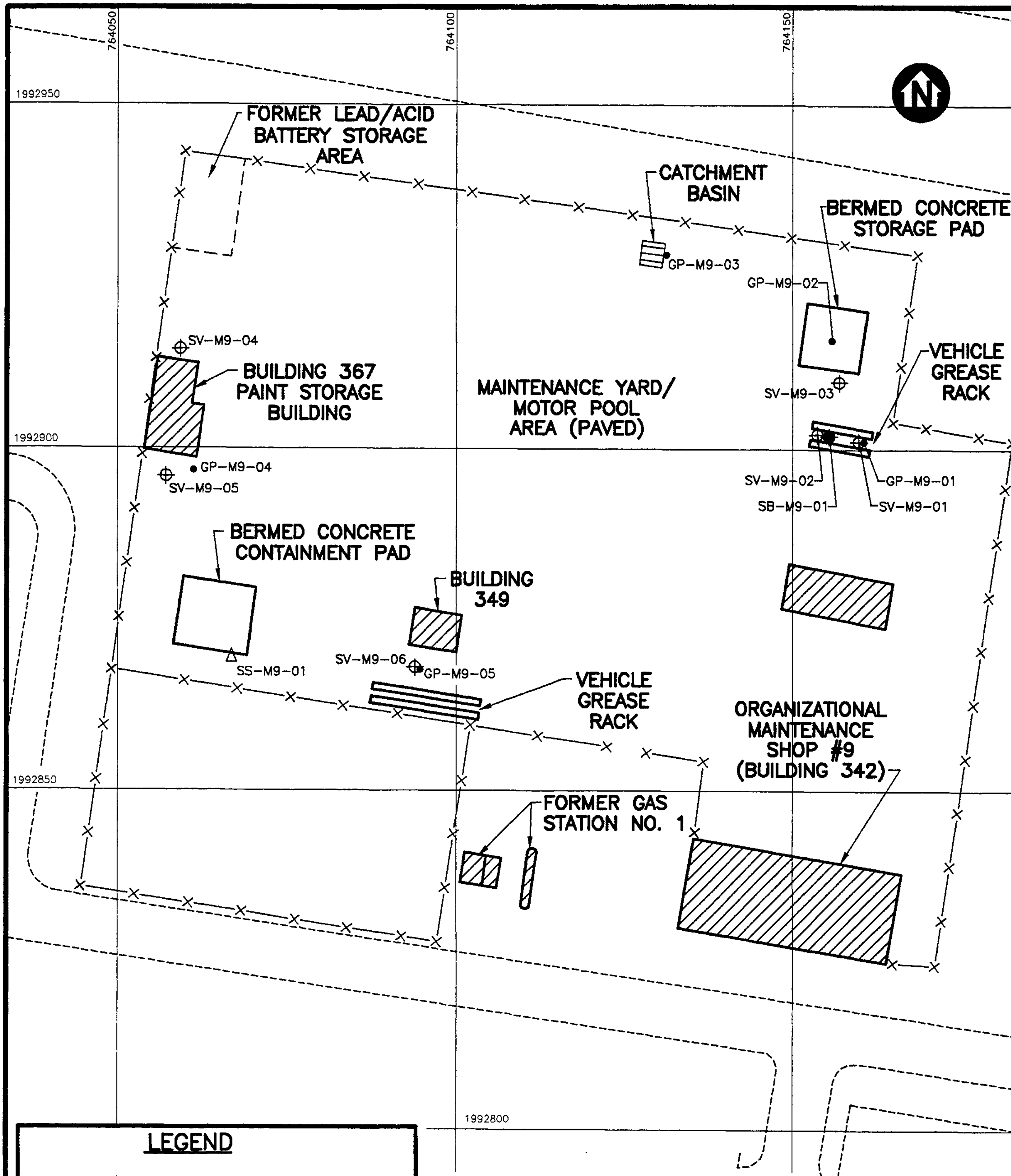

LEGEND

SS-M9-01	Δ	SURFACE SOIL SAMPLE LOCATION
GP-M9-05	•	GEOPROBE EXPLORATION
SB-M9-01	●	SOIL BORING LOCATION
SV-M9-03	⊕	SOIL VAPOR SURVEY POINT

0 10 20 40 METERS

0 33 66 131 FEET

SCALE: 1"=20 METERS

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 6-2
OMS #9 EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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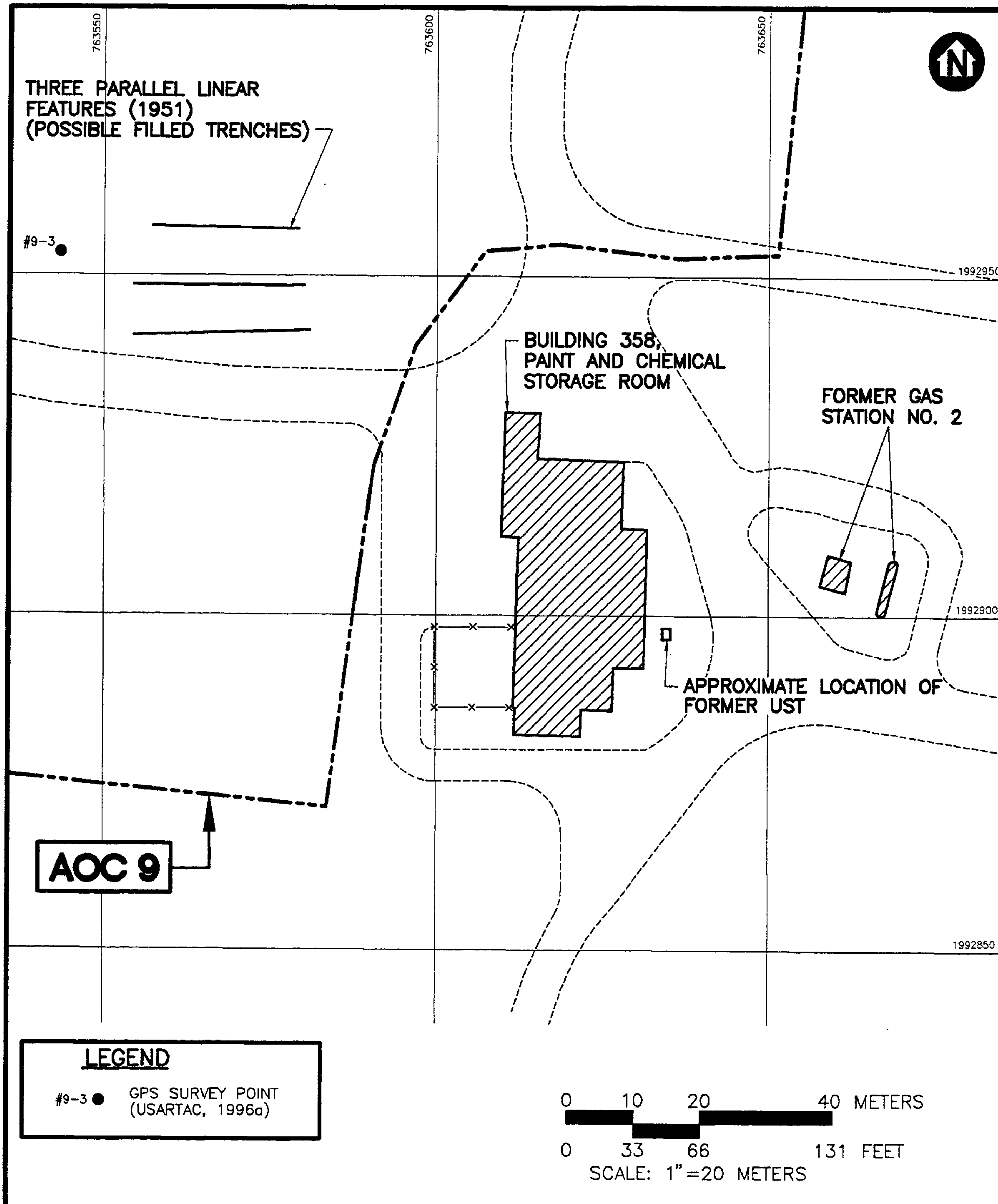

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS AND BUILDINGS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 7-1
PAINT AND CHEMICAL STORAGE ROOM, BUILDING 358
SITE PLAN AND HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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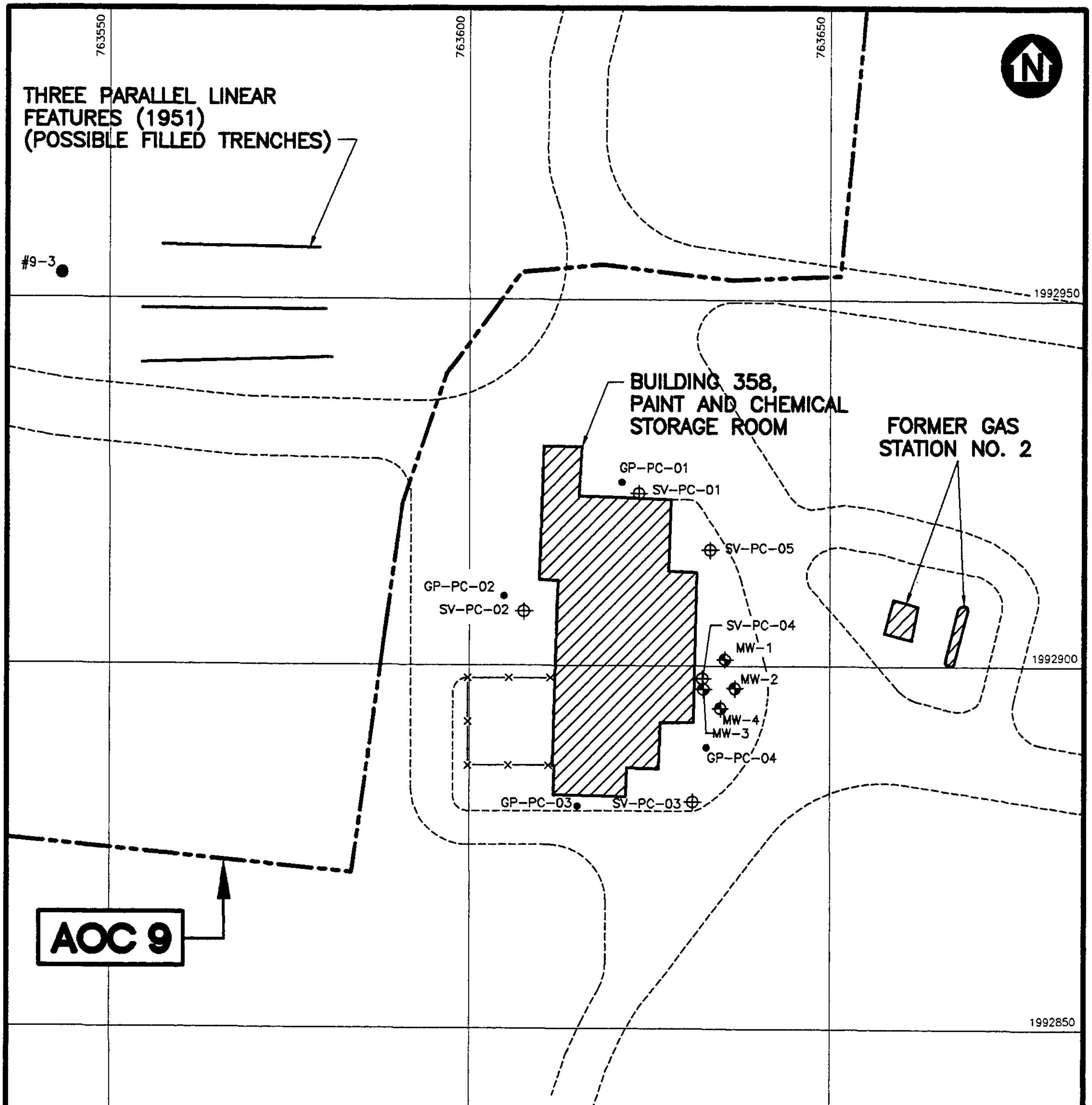

LEGEND

#9-3 ●	GPS SURVEY POINT (USARTAC, 1996a)
GP-PC-01 •	GEOPROBE EXPLORATION
SV-PC-03 ⊕	SOIL VAPOR SURVEY POINT
MW-1 ⊕	MONITORING WELL INSTALLED IN 1996 AFTER UST REMOVAL BY PUERTO RICO ARMY NATIONAL GUARD

0 10 20 40 METERS
0 33 66 131 FEET
SCALE: 1"=20 METERS

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS AND BUILDINGS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 7-2
PAINT AND CHEMICAL STORAGE ROOM, BUILDING 358
EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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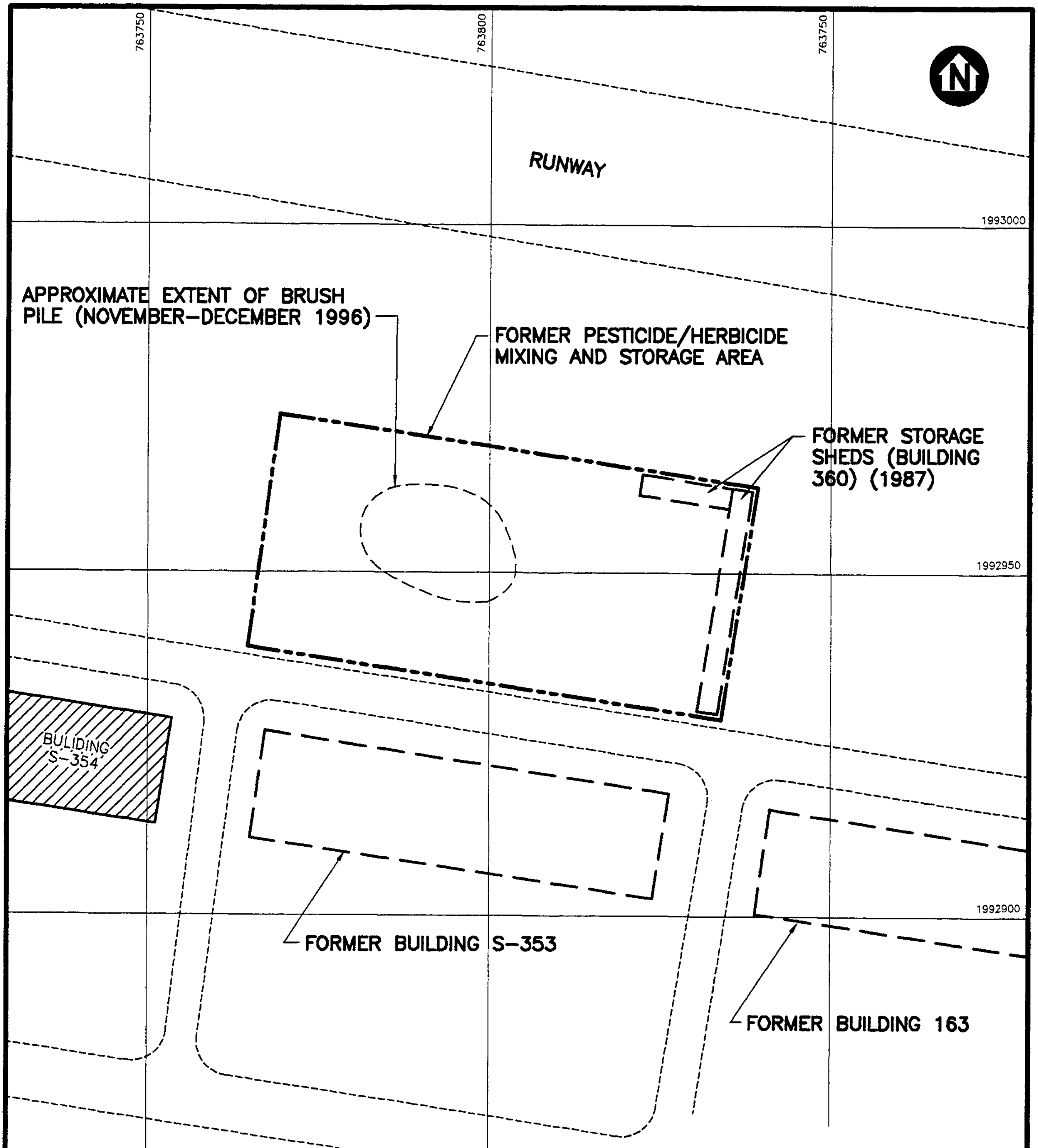

0 10 20 40 METERS

0 33 66 131 FEET

SCALE: 1"=20 METERS

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 8-1
PESTICIDE/HERBICIDE MIXING AND STORAGE AREA SITE PLAN AND HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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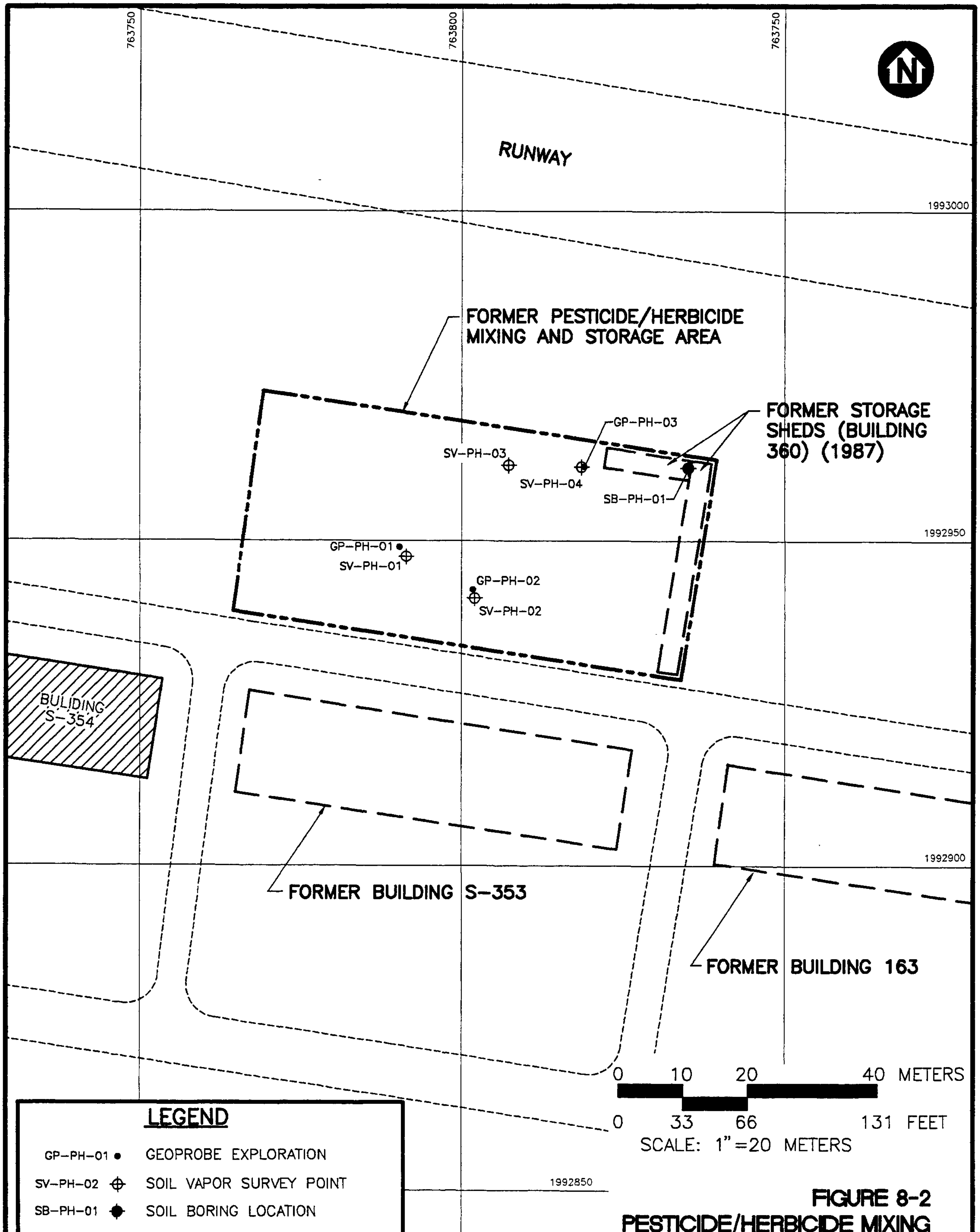

NOTES:

LOCATIONS OF STRUCTURES ARE APPROXIMATE.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS OBTAINED FROM USAEC.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 8-2
PESTICIDE/HERBICIDE MIXING AND STORAGE AREA EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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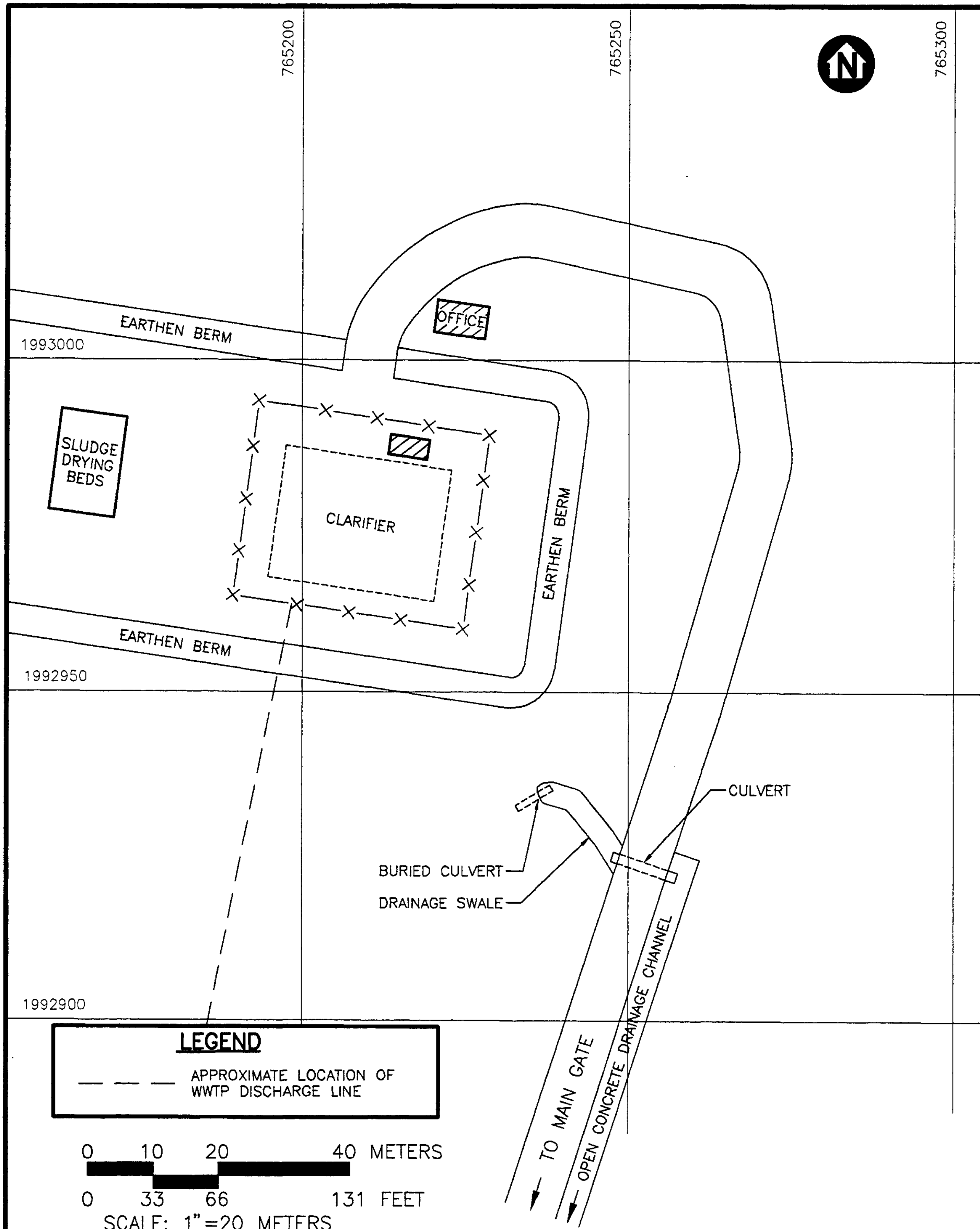

NOTES:

HISTORICAL FEATURES DIGITIZED FROM JULY 1996 HISTORICAL PHOTO ANALYSIS, FORT ALLEN, BY THE USARTAC.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS PROVIDED BY USAEC, AND GPS SURVEY CONDUCTED BY ABB-ES IN NOVEMBER 1996.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 12-1
WWTP SITE PLAN AND HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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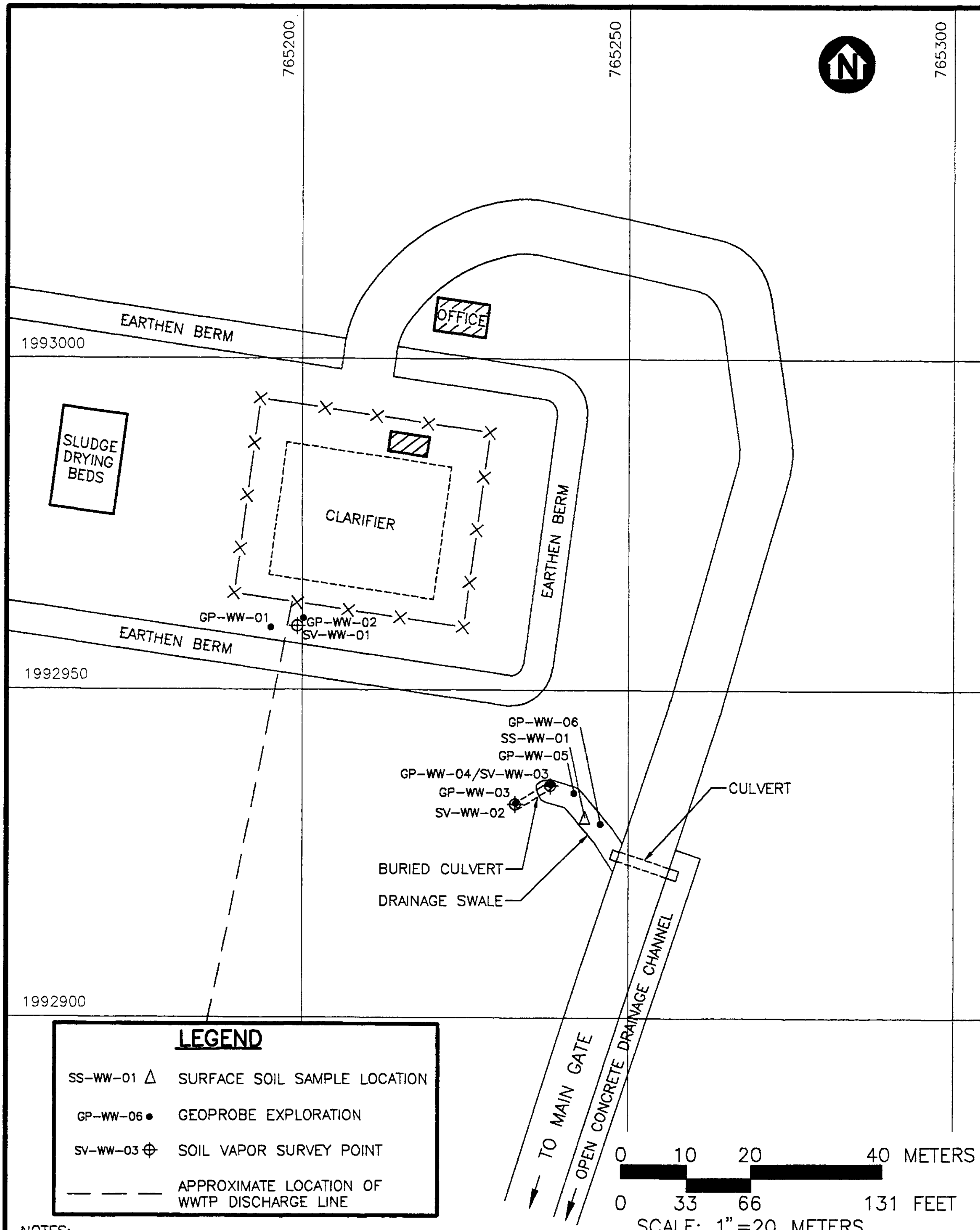

NOTES:

HISTORICAL FEATURES DIGITIZED FROM JULY 1996 HISTORICAL PHOTO ANALYSIS, FORT ALLEN, BY THE TERRAIN ANALYSIS CENTER.

ROADS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS PROVIDED BY USAEC, AND GPS SURVEY CONDUCTED BY ABB-ES IN NOVEMBER 1996.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 12-2
WWTP EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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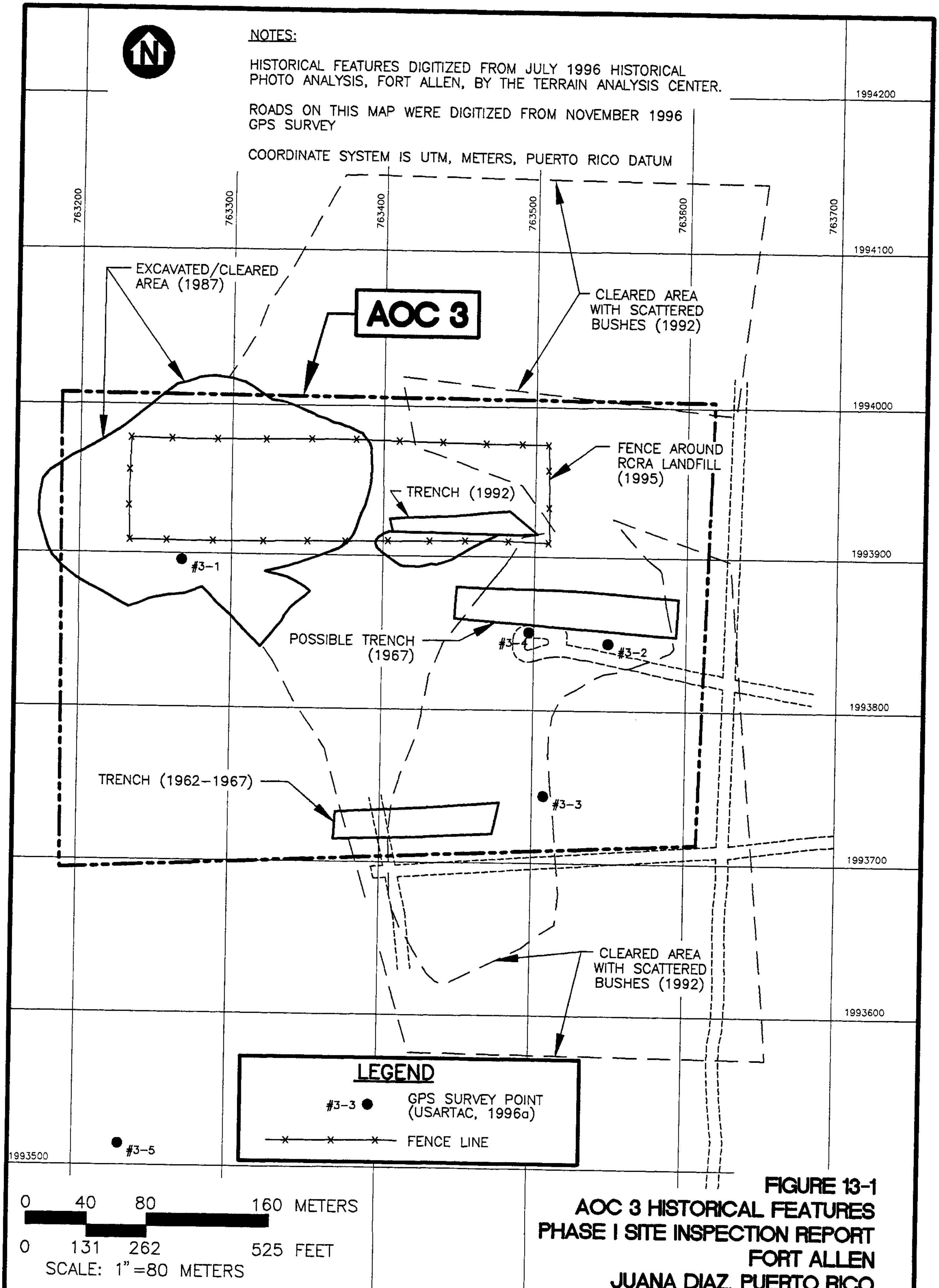
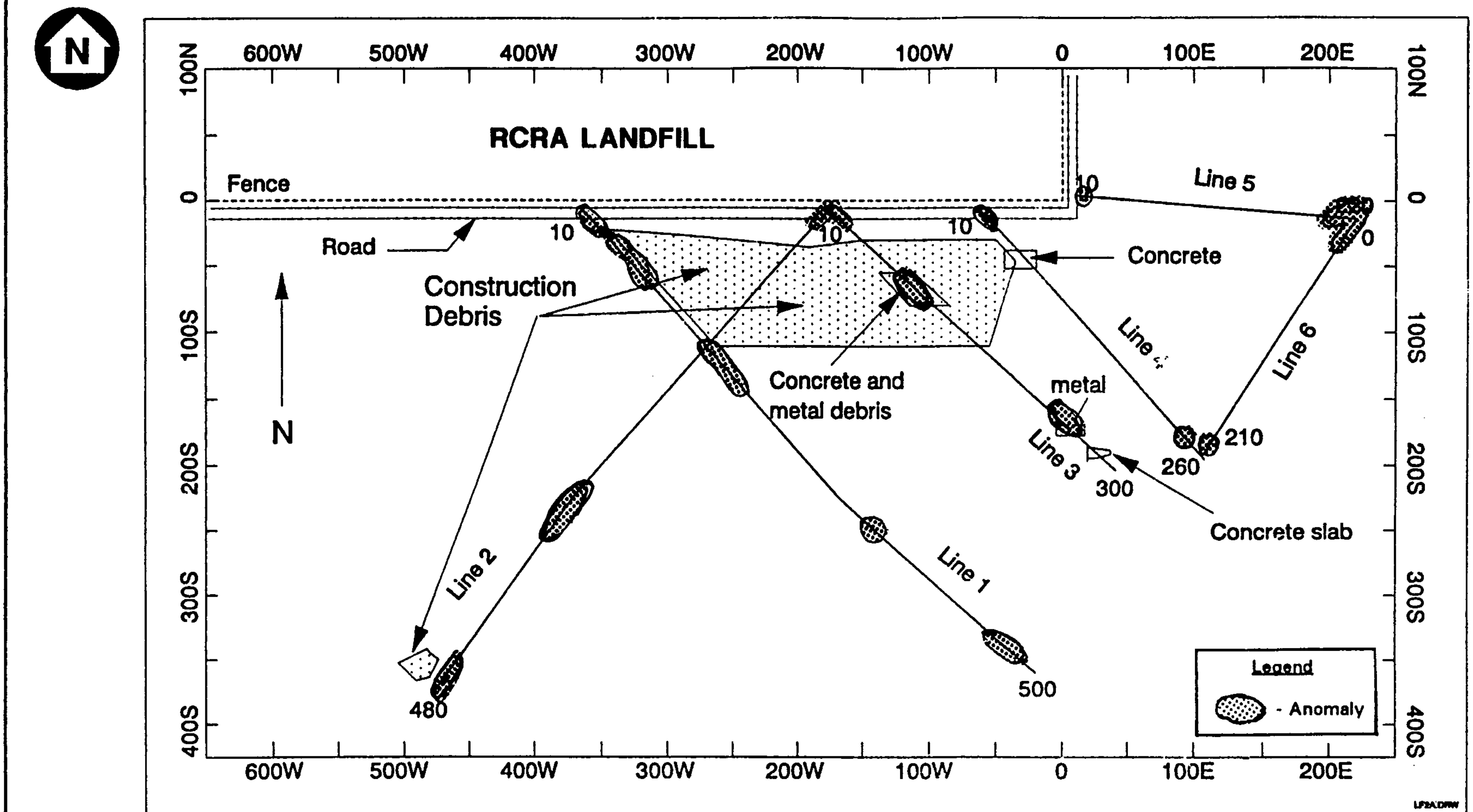


FIGURE 13-1
AOC 3 HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

T:\9890-02\9890F008.DWG 01-30-97



Note: Scale is in feet.

Source: Geophysical Investigation of Fort Allen, Puerto Rico, USACE Waterways Experiment Station, January 1996.

FIGURE 13-2
INTEGRATED ANOMOLY MAP, RCRA LANDFILL, AOC 3
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

W9610028D(c) C&P

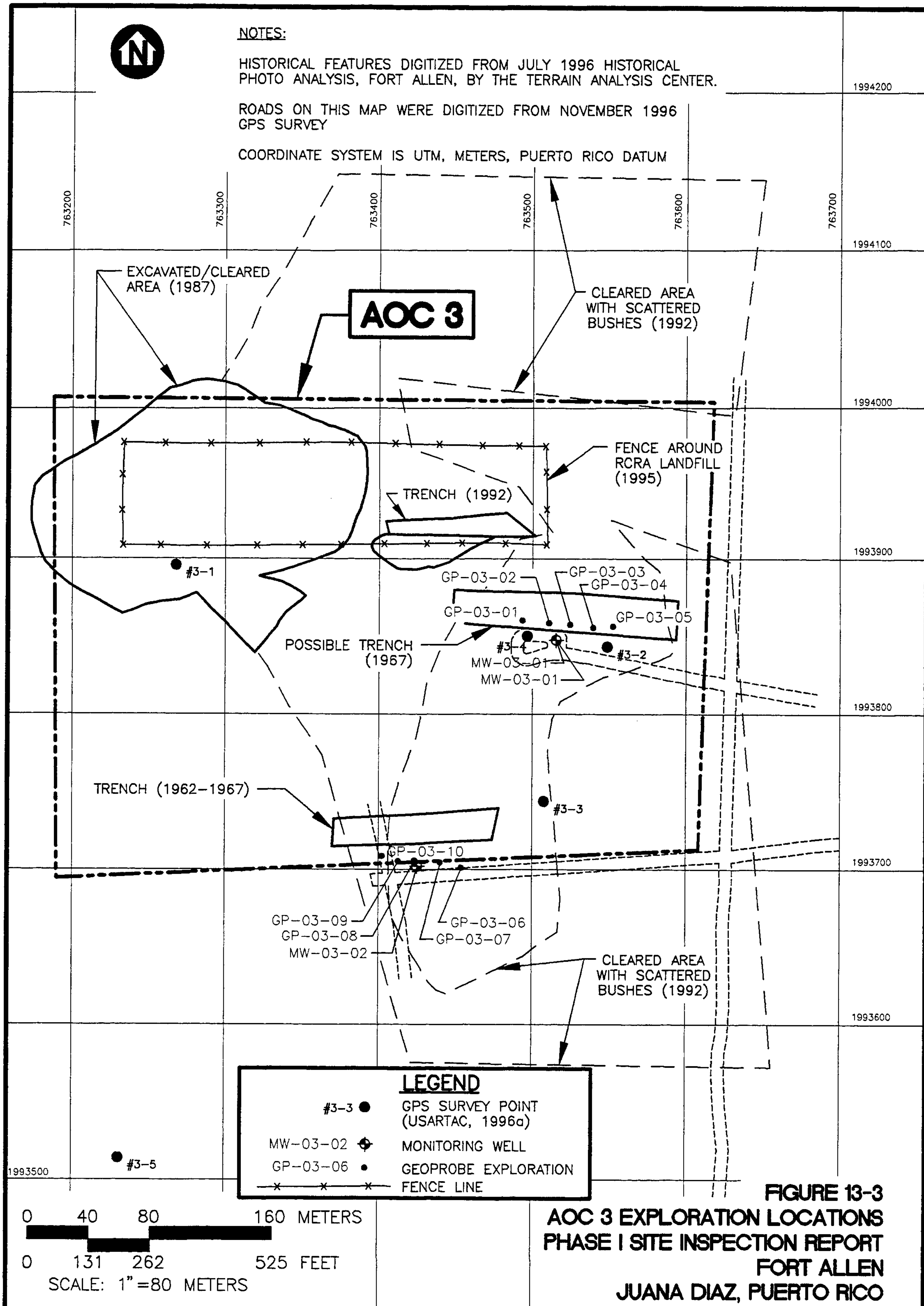
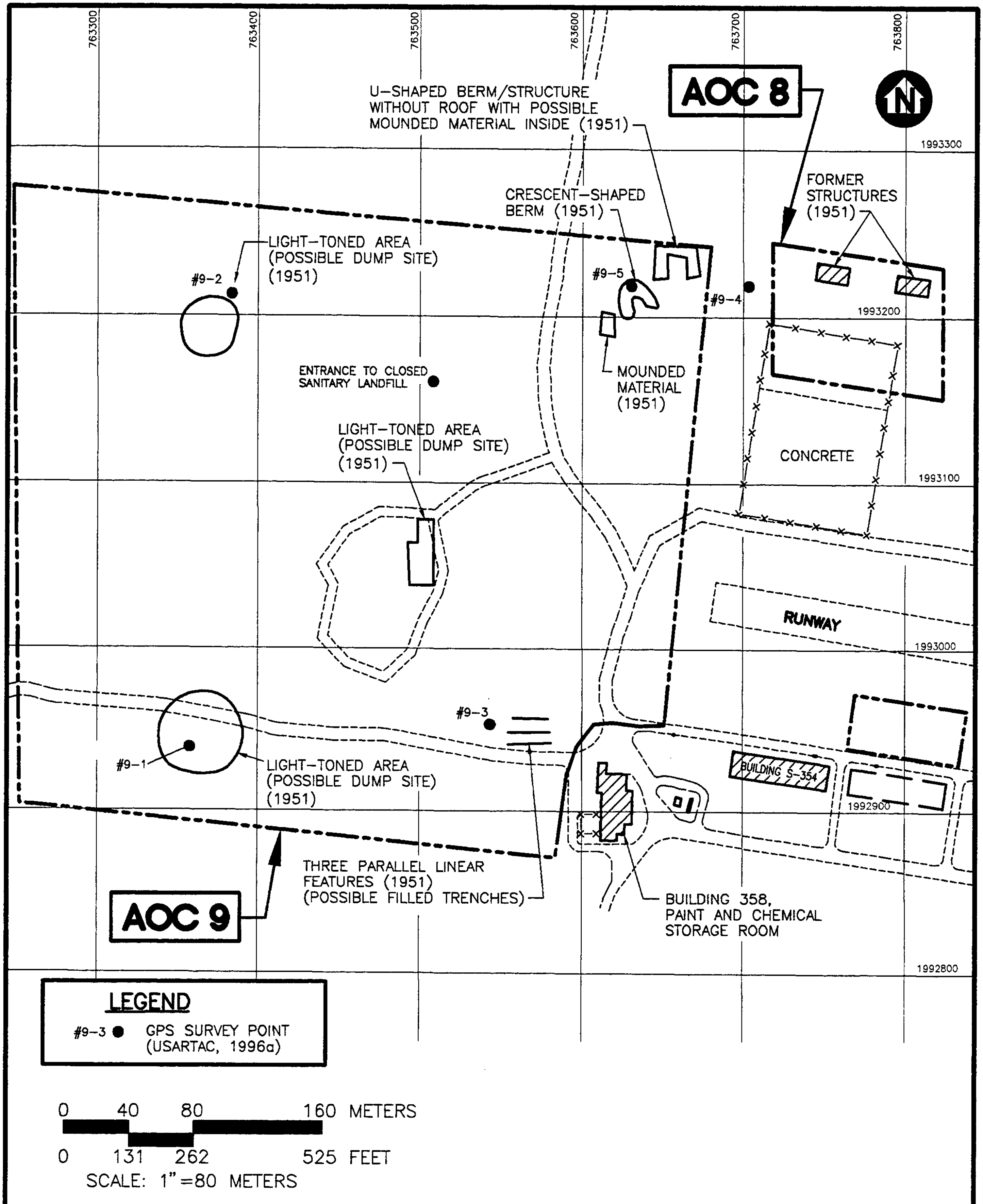


FIGURE 13-3
AOC 3 EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO
ABB Environmental Services, Inc.



NOTES:

HISTORICAL FEATURES DIGITIZED FROM JULY 1996 HISTORICAL PHOTO ANALYSIS, FORT ALLEN, BY THE TERRAIN ANALYSIS CENTER.

ROADS AND SOME BUILDINGS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS PROVIDED BY USAEC, AND GPS SURVEY CONDUCTED BY ABB-ES IN NOVEMBER 1996.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 14-1
AOCs 8 AND 9 SITE PLAN AND HISTORICAL FEATURES
PHASE I SITE INSPECTION REPORT
FORT ALLEN SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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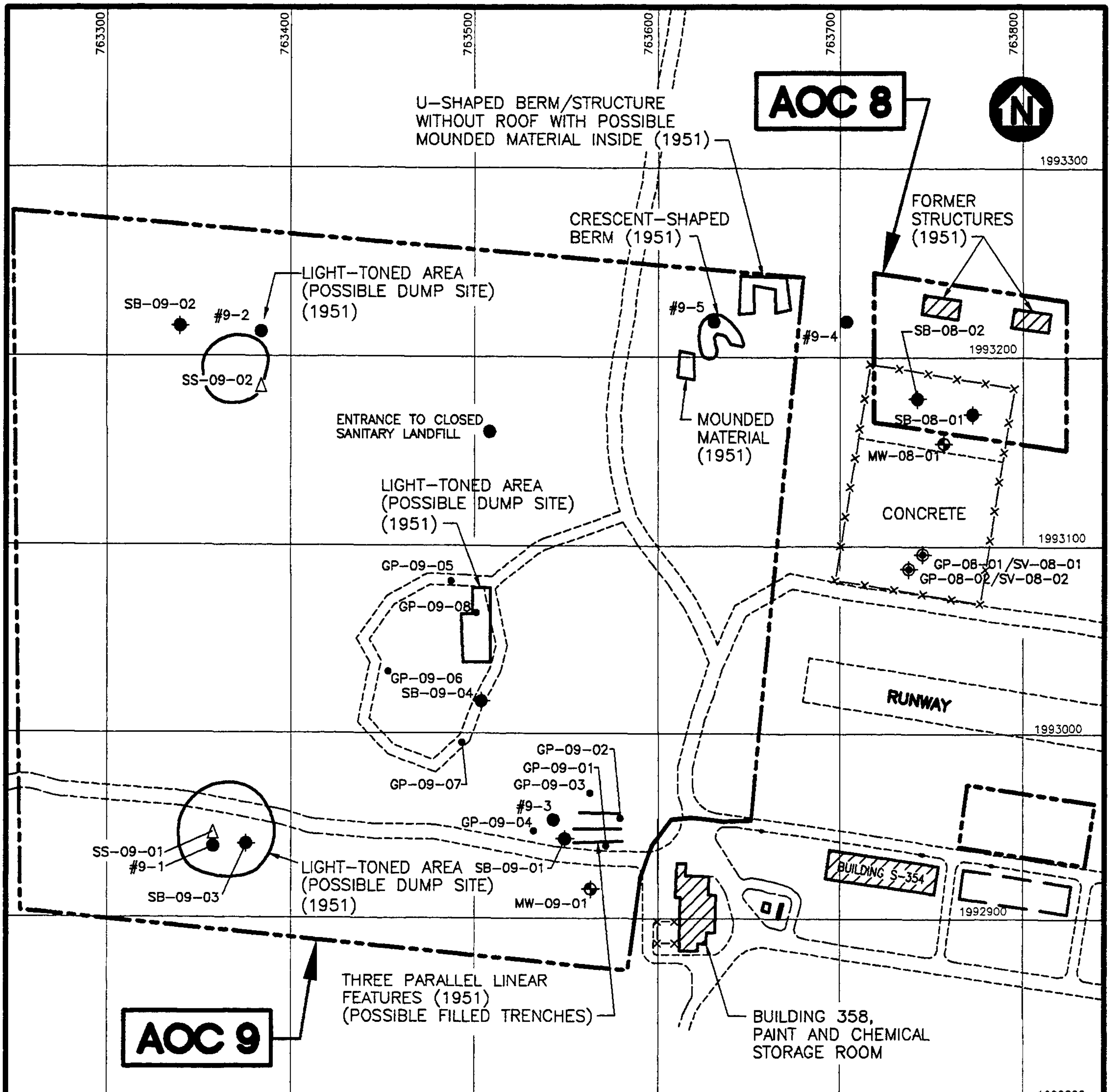

LEGEND

#9-3 ●	GPS SURVEY POINT (USARTAC, 1996a)
GP-09-06 •	GEOPROBE EXPLORATION
SB-09-04	SOIL BORING LOCATION
SV-08-01	SOIL VAPOR SURVEY POINT
MW-09-01	MONITORING WELL

0 40 80 160 METERS

0 131 262 525 FEET

SCALE: 1"=80 METERS

NOTES:

HISTORICAL FEATURES DIGITIZED FROM JULY 1996 HISTORICAL PHOTO ANALYSIS, FORT ALLEN, BY THE TERRAIN ANALYSIS CENTER.

ROADS AND SOME BUILDINGS ON THIS MAP WERE DIGITIZED FROM AS-BUILT DRAWINGS PROVIDED BY USAEC, AND GPS SURVEY CONDUCTED BY ABB-ES IN NOVEMBER 1996.

COORDINATE SYSTEM IS UTM, METERS, PUERTO RICO DATUM.

FIGURE 14-2
AOCs 8 AND 9 EXPLORATION LOCATIONS
PHASE I SITE INSPECTION REPORT
FORT ALLEN
JUANA DIAZ, PUERTO RICO

ABB Environmental Services, Inc.

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TABLE ES-1
SUMMARY OF FINDINGS AND RECOMMENDATIONS

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

POTENTIAL WASTE SOURCE AREA OR AOC	MEDIUM INVESTIGATED	CONTAMINANTS	STATUS/RECOMMENDATIONS
FORMER NAVY LANDFILL	N/A	N/A	Due to the need for additional pre-investigation scoping activities and health and safety concerns, this site was not investigated in the Phase I SI. Investigations are recommended for a Phase II SI.
FORMER INS LANDFILL	N/A	N/A	Investigations are to be completed by the U.S. Navy as part of a proposed over-the-horizon radar installation
OMS #9	Soil Soil Vapor	Fuel-related VOCs and SVOCs in surface and subsurface soil. VOCs in soil vapor.	Additional soil borings and groundwater sampling are recommended to evaluate fuel and potential chlorinated solvent contamination.
PAINT AND CHEMICAL STORAGE ROOM, BUILDING 358	Soil Soil Vapor	Fuel-related VOCs and chloroform in soil vapor.	Review of groundwater sample data from monitoring wells installed by the Puerto Rico Army National Guard (PRARNG) may provide further insight into the need for additional investigations at the site.
PESTICIDE/HERBICIDE MIXING AND STORAGE AREA	Soil Soil Vapor	Fuel-related VOCs in subsurface soils and soil vapor. Tentative confirmation of DDT in subsurface soils.	Additional subsurface soil and groundwater sampling are recommended to further assess potential subsurface soil contamination.
ELECTRICAL TRANSFORMERS	Soil	Mercury, lead, and heavy hydrocarbons in surface soil.	Additional surface and subsurface soil sampling is recommended to further assess potential contamination.
UNDERGROUND STORAGE TANKS (USTs)	N/A	N/A	Incorporate results of the investigation by the PRARNG into a revised Phase I SI.
ABOVEGROUND STORAGE TANKS (ASTs)	N/A	N/A	Incorporate results of the investigation by the PRARNG into a revised Phase I SI.
WASTEWATER TREATMENT PLANT (WWTP)	Soil Soil Vapor	Chloroform in soil vapor.	No further action.
AOC 3	Soil Groundwater	None	Additional groundwater sampling downgradient of the RCRA landfill is recommended to assess potential impacts to groundwater. Obtain RCRA Part B permit, if existing.
AOC 8	Soil Soil Vapor Groundwater	None	Additional groundwater sampling downgradient (southeast) of the structures identified in the 1951 photograph to assess potential impacts to groundwater.
AOC 9	Soil Groundwater	Herbicides in surface and subsurface soils.	Additional groundwater sampling is recommended to assess potential impacts to groundwater from herbicides detected in soils. Subsurface soil and groundwater sampling is recommended at the cluster of berms identified in the 1951 aerial photograph, and located in the northeast corner of AOC 9.

Notes:

AOC = Area of Concern
SI = Site Inspection
RCRA = Resource Conservation and Recovery Act
UST = underground storage tank
AST = aboveground storage tank

DDT = dichlorodiphenyltrichloroethane
VOC = volatile organic compound
SVOC = semivolatile organic compound
N/A = Not Applicable

TABLE 1-1
SITES IDENTIFIED IN THE PRELIMINARY ASSESSMENT AND AREAS OF CONCERN

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

NAME	REPORT OF INITIAL IDENTIFICATION[1]	LOCATION WITHIN FORT ALLEN	CONCERN/FEATURES	INVESTIGATION RESPONSIBILITY[2]
Former Navy Landfill (included in AOC 1)	PA	Northwest corner of Fort Allen	Former U.S. Navy Landfill. The 1951, 1962, and 1963 aerial photographs show cleared areas, with trenches, mounds, and areas of disturbed ground. (WESTON, 1994; USARTAC, 1996).	Phase II
Former Immigration and Naturalization Service Landfill (AOC 2)	PA	South-southeast of U.S. Navy Radio Station Between Northwest-Southeast and East-West Runways	Former Immigration and Naturalization Service Landfill (Weston, 1994). A circular concrete feature has been identified in aerial photographs since 1943. Trenches, excavations, and graded areas are seen on the 1985 aerial photographs (USARTAC, 1996).	U.S. Navy

TABLE 1-1
SITES IDENTIFIED IN THE PRELIMINARY ASSESSMENT AND AREAS OF CONCERN

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

NAME	REPORT OF INITIAL IDENTIFICATION[1]	LOCATION WITHIN FORT ALLEN	CONCERN/FEATURES	INVESTIGATION RESPONSIBILITY[2]
Organizational Maintenance Shop # 9 (OMS #9), Building 342	PA	Center of Cantonment Area	General vehicle maintenance, changing vehicle oil within Building 342 or on grease racks in the yard. Storage of motor oil and spent solvent in 55-gallon drums, storage of vehicle batteries, brake lining replacement, and parts cleaning (within Building 342). In addition, virgin oil, lubricants, grease, paints, acetone, and silicon sealing compounds are stored on site. Three wash racks drain into an oil-water separator which leads to a sanitary sewer. A 5,000 gallon UST contains MOGAS (WESTON, 1994).	Phase I
Paint and Chemical Storage Room, Building 358	PA	West edge of the Cantonment Area	Storage of flammable materials, paints, adhesives, and sealants (WESTON, 1994).	Phase I
Pesticide/ Herbicide Mixing and Storage Area, Building 360	PA	Northwest corner of the Cantonment Area	Mixing and storage of pesticides, industrial strippers, and acid cleaners. In addition, oils and lubricants were stored on-site during the PA visit (WESTON, 1994).	Phase I

TABLE 1-1
SITES IDENTIFIED IN THE PRELIMINARY ASSESSMENT AND AREAS OF CONCERN

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

NAME	REPORT OF INITIAL IDENTIFICATION[1]	LOCATION WITHIN FORT ALLEN	CONCERN/FEATURES	INVESTIGATION RESPONSIBILITY[2]
AOC 8	SI	Northwest corner of the East-West Runway	The 1951 aerial photograph indicates that this area was used for storage (USARTAC, 1996) and potentially an airplane cleaning/degreasing area (USAEC, 1996)	Phase I
AOC 9	SI	Western edge of the East-West Runway	The 1951 aerial photograph shows several light-toned areas, three parallel linear features (possibly trenches), and a cluster of berms (USARTAC, 1996).	Phase I
AOC 4	SI	Northern boundary of Fort Allen	An abandoned and breached irrigation pond. This feature is seen on the 1936, 1951, 1962, and 1963 aerial photographs. (USARTAC, 1996).	Phase II
AOC 5	SI	Southeast of the U.S. Navy Radio Station	This AOC covers a large part of the northwest-southwest runway area. A large crescent shape berm is located just North of the east-west runway on the 1943 and 1963 aerial photographs. Several clearings and graded areas are shown in the 1962 and 1977 aerial photographs. (USARTAC, 1996).	U.S. Navy

TABLE 1-1
SITES IDENTIFIED IN THE PRELIMINARY ASSESSMENT AND AREAS OF CONCERN

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

NAME	REPORT OF INITIAL IDENTIFICATION[1]	LOCATION WITHIN FORT ALLEN	CONCERN/FEATURES	INVESTIGATION RESPONSIBILITY[2]
AOC 6	SI	Eastern end of Fort Allen	Historical photographs suggest that this area was used as a training site from 1962 to 1992. A canteen and a horse farm were operated by the U.S. Navy in this area (USARTAC, 1996).	U.S. Navy
AOC 7	SI	Northeast corner of Fort Allen	A probable irrigation pond was noted on the 1936 aerial photograph. On the 1967 and 1971 aerial photographs a trench feature is located at the southern end of the AOC. Possible trenches and an excavated area are shown in the 1977 aerial photograph near the former pond (USARTAC, 1996).	Phase II

Notes:

1) PA - 1994 Preliminary Assessment Report (WESTON, 1994)
SI - 1996 Site Investigation Report (USARTAC, 1996)
2) Phase I: Investigations conducted in November 1996 as part of the Site Inspection (SI).
Phase II: Investigations to be conducted following completion of the phase I SI.
PRARNG: Puerto Rico Army National Guard investigations.
U.S. Navy: Investigations to be conducted by the U.S. Navy as part of a radar antenna installation.
WESTON : (Roy F. Weston, Inc.), 1994, Final Preliminary Assessment of Army National Guard Facility, Fort Allen, Juana Diaz, Puerto Rico. January 1994.

TABLE 3-1
WATER TABLE ELEVATIONS

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

MONITORING WELL	DATE	TOP OF PVC MONITORING WELL RISER ELEVATION (meters,msl)	DEPTH TO WATER FROM TOP OF PVC RISER (feet)	DEPTH TO WATER FROM TOP OF PVC RISER (meters)	WATER TABLE ELEVATION (meters,msl)	WATER TABLE ELEVATION (feet,msl)
MW-03-01	12/3/96	17.013	30.12	9.181	7.832	25.70
MW-03-02	12/3/96	15.406	26.84	8.181	7.225	23.70
MW-08-01	12/3/96	10.994	20.08	6.120	4.874	15.99
MW-09-01	12/3/96	9.957	16.89	5.148	4.809	15.78

NOTES: 1) PVC = polyvinyl chloride
2) msl = mean sea level

TABLE 3-2
SUMMARY OF DDT IMMUNOASSAY TEST RESULTS

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ANALYTICAL BATCH	SAMPLE DESIGNATION	OPTICAL DENSITY	DF	RESULT (PPM)	COMMENT
1	Negative Control (NC)	0.06	NA	NA	QC Run/non-compliant
	0.2 ppm Calibrator (C1)	0.04	NA	NA	*
	1.0 ppm Calibrator (C2)	1.03	NA	NA	*
	10 ppm Calibrator (C3)	0.03	NA	NA	*
	PPH0104X (GP-PH-01)	1.13	2	<0.2	
	PPH0204X (GP-PH-02)	0.04	2	NC	Possible Positive Response
	PPH0304X (GP-PH-03)	1.41	2	<0.2	
2	Negative Control	1.59	NA	NA	QC Run/Compliant
	0.2 ppm Calibrator	1.31	NA	NA	
	1.0 ppm Calibrator	0.03	NA	NA	*
	10 ppm Calibrator	0.63	NA	NA	
	PPH0104X (GP-PH-01)	1.19	2	>0.2	Positive Response
	PPH0204X (GP-PH-02)	0.03	2	>10	Positive Response
	PPH0304X (GP-PH-03)	1.40	2	<0.2	

Notes:

DF = Dilution Factor
NA = Not Applicable
NC = Negative Control
* = Non-linear calibration result

TABLE 3-3
SUMMARY OF USAEC AND USEPA ANALYTICAL METHODS

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

PARAMETER	INSTRUMENTATION	SOIL[1]	WATER[1]
USAEC Methods			
VOCs	GC/MS	NA	VMS1-WA/8240
SVOCs	GC/MS	SMV1-SO/8270	SMV1-WA/8270
Inorganics	ICP-MS	ICM1-SO/6020	ICM1-WA/6020
	ICP	ICP-SO/6010	ICP2-WA/6010
Lead	GFAA	GPB1-SO/7421	GPB1-WA/7421
Selenium	GFAA	GSE1-SO/7740	GSE1-WA/7740
Thallium	GFAA	GTL1-SO/7841	GTL1-WA/7841
Mercury	CVAA	GHG1-SO/7471	GHG1-WA/7470
USEPA Methods			
VOCs	GC/MS	8260A	NA
Halogenated VOCs	GC/HECD	8010B	NA
TPH - GRO	GC/FID	8015A	NA
TPH - diesel	GC/FID	8015A	NA
Oil and Grease	gravimetric	413.1	NA

Notes:
1) USAEC Method / Comparable USEPA Method Number

GC	= Gas Chromatography
MS	= Mass Spectrometry
ECD	= Electron Capture Detector
ICP	= Inductively Coupled Plasma
HECD	= Hall Electrolytic Conductivity Detector
GFAA	= Graphite Furnace Atomic Absorption
CVAA	= Cold Vapor Atomic Adsorption
NA	= not applicable
TPH	= Total Petroelum Hydrocarbons
GRO	= Gasoline Range Organics
DRO	= Diesel Range Organics
VOCs	= Volatile Organic Compounds
SVOCs	= Semivolatile Organic Compounds

TABLE 3-4
GROUNDWATER STANDARDS

FORT ALLEN PHASE I SITE INSPECTION
JAUNA DIAZ, PUERTO RICO

ANALYTE	FEDERAL MCL (mg/L)	PUERTO RICO STANDARDS (mg/L)
VOLATILE ORGANIC COMPOUNDS (VOCs)		
1,1,1-Trichloroethane	0.2	0.2
1,1,2,2-Tetrachloroethane	-	-
1,1,2-Trichloroethane	0.005	-
1,1-Dichloroethane	-	-
1,1-Dichloroethylene	0.007	-
1,2-Dibromoethane (EDB)	0.00005	-
1,2-Dibromo-3-Chloropropane	0.0002	-
1,2-Dichloroethane	0.005	0.005
1,2-Dichloroethene (total)	-	0.007
1,2-Dichloropropane	0.005	-
2-Butanone	-	-
2-Hexanone	-	-
4-Methyl-2-Pentanone	-	-
Acetone	-	-
Benzene	0.005	0.005
Bromodichloromethane	-	-
Bromoform	-	-
Bromomethane	-	-
Carbon Disulfide	-	-
Carbon Tetrachloride	0.005	0.005
Chlorobenzene	0.1	-
Chloroethane	-	-
Chloroform	-	-
Chloromethane	0.005	-
cis-1,2-Dichloroethylene	0.07	-
cis-1,3-Dichloropropene	-	-
Dibromochloromethane	-	-
Ethylbenzene	0.7	-
Methylene Chloride	0.005	-
Styrene	0.1	-
Tetrachloroethylene	0.005	0.005
Toluene	1	-
Total Xylenes	10	-
trans-1,2-Dichloroethylene	0.1	-
trans-1,3-Dichloropropene	-	-
Trichloroethylene	0.005	0.005
Vinyl Chloride	0.002	0.002
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		-
1,2,4-Trichlorobenzene	0.07	-
1,2-Dichlorobenzene	0.6	-
1,3-Dichlorobenzene	0.6	0.075(3)
1,4-Dichlorobenzene	0.075	0.075(3)
2,4,5-Trichlorophenol	-	-

TABLE 3-4
GROUNDWATER STANDARDS

FORT ALLEN PHASE I SITE INSPECTION
JAUNA DIAZ, PUERTO RICO

ANALYTE	FEDERAL MCL (mg/L)	PUERTO RICO STANDARDS (mg/L)
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs) - continued		
2,4,6-Trichlorophenol	-	-
2,4-Dichlorophenol	-	-
2,4-Dimethylphenol	-	-
2,4-Dinitrophenol	-	-
2,4-Dinitrotoluene	-	-
2,6-Dinitrotoluene	-	-
2-Chloronaphthalene	-	-
2-Chlorophenol	-	-
2-Methylnaphthalene	-	-
2-Methylphenol	-	-
2-Nitroaniline	-	-
2-Nitrophenol	-	-
3,3'-Dichlorobenzidine	-	-
3-Nitroaniline	-	-
4,6-Dinitro-2-methylphenol	-	-
4-Bromophenyl-phenylether	-	-
4-Chloroaniline	-	-
4-Chlorophenyl-phenylether	-	-
4-Chloro-3-Methylphenol	-	-
4-Methylphenol	-	-
4-Nitroaniline	-	-
4-Nitrophenol	-	-
Acenaphthene	-	-
Acenaphthylene	-	-
Anthracene	-	-
Benzo(2)Anthracene	-	-
Benzo(2)Pyrene	0.0002	-
Benzo(b)Fluoranthene	-	-
Benzo(g,h,i)perylene	-	-
Benzo(k)Fluoranthene	-	-
bis(2-Chloroethoxy)methane	-	-
bis(2-Chloroethyl)ether	-	-
bis(2-Chloroisopropyl)ether	-	-
bis(2-Ethylhexyl)phthalate	0.006	-
Butylbenzylphthalate	-	-
Carbazole	-	-
Chrysene	-	-
Dibenzofuran	-	-
Dibenz(a,h)Anthracene	-	-
Diethylphthalate	-	-
Dimethylphthalate	-	-
Di-n-butylphthalate	-	-
Di-n-octylphthalate	-	-
Fluoranthene	-	-

TABLE 3-4
GROUNDWATER STANDARDS

FORT ALLEN PHASE I SITE INSPECTION
JAUNA DIAZ, PUERTO RICO

ANALYTE	FEDERAL MCL (mg/L)	PUERTO RICO STANDARDS (mg/L)
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs) - continued		
Fluorene	-	-
Hexachlorobenzene	0.001	-
Hexachlorobutadiene	-	-
Hexachlorocyclopentadiene	0.05	-
Hexachloroethane	-	-
Indeno(1,2,3-c,d)Pyrene	-	-
Isophorone	-	-
Naphthalene	-	-
Nitrobenzene	-	-
Nitrophenols	-	-
N-Nitrosodiphenylamine	-	-
N-Nitroso-di-n-propylamine	-	-
Pentachlorophenol	0.001	0.0007 (2)
Phenanthrene	-	-
Phenolic Substances	-	0.001(1)
Pyrene	-	-
PESTICIDES/HERBICIDES/PCBs		-
4,4'-DDD	-	-
4,4'-DDE	-	-
4,4'-DDT	-	-
Aldrin	-	-
alpha-BHC	-	-
alpha-Chlordane	0.002	-
Aroclor-1016	0.0005	-
Aroclor-1221	0.0005	-
Aroclor-1232	0.0005	-
Aroclor-1242	0.0005	-
Aroclor-1248	0.0005	-
Aroclor-1254	0.0005	-
Aroclor-1260	0.0005	-
beta-BHC	-	-
delta-BHC	-	-
Dieldrin	-	-
Endosulfan I	-	0.056 (2)
Endosulfan II	-	-
Endosulfan Sulfate	-	-
Endrin	0.002	0.0023 (2)
Endrin Ketone	-	-
gamma-BHC (Lindane)	0.0002	-
gamma-Chlordane	0.002	-
Heptachlor	0.0004	-
Heptachlor Epoxide	0.0002	-
Methoxychlor	0.04	0.020 (2)
Toxaphene	0.003	0.0002 (2)

TABLE 3-4
GROUNDWATER STANDARDS

FORT ALLEN PHASE I SITE INSPECTION
JAUNA DIAZ, PUERTO RICO

ANALYTE	FEDERAL MCL (mg/L)	PUERTO RICO STANDARDS (mg/L)
INORGANICS		-
Aluminum	0.05-0.2 (S)	-
Antimony	0.006	-
Arsenic	0.05	0.000022 (HH)
Barium	2	-
Beryllium	0.004	-
Cadmium	0.005	0.005 (DW)
Calcium	-	-
Chromium III	-	-
Chromium VI	-	-
Chromium (Total)	0.1	-
Cobalt	-	-
Copper	1.3	-
Iron	0.3 (S)	-
Lead	0.015	0.050 (DW)
Magnesium	-	-
Manganese	0.05 (S)	-
Mercury	0.002	-
Nickel	0.1	-
Potassium	-	-
Selenium	0.05	-
Silver	0.1 (S)	-
Sodium	-	-
Sulfate	-	-
Thallium	0.002	-
Vanadium	-	-
Zinc	5 (S)	-
Cyanide	0.2	-

SOURCES:

U.S. Environmental Protection Agency (USEPA), 1994. Fact Sheet: Drinking Water Regulations and Health Advisories; Office of Water, Washington D.C., May, 1995

Puerto Rico Environmental Quality Board Numeric Groundwater Quality Standards, Section 3.1.9 of Puerto Rico Water Quality Standards Regulation

NOTES:

(1) This parameter will be evaluated to determine the feasibility of establishing standards for more specific groups of substances.
(2) For groundwaters that flow into stream beds, estuarine waters or wetlands.
(3) Total dichlorobenzenes
DW = Protection of the waterbody for use as source of drinking water supply.
HH = Protection of the waterbody or aquatic life for reasons of human health.
mg/L = milligrams per Liter
MCL = maximum contaminant level
S = Secondary Drinking Water Standard, not based on direct health effects.

TABLE 6-1
SUMMARY OF TECHNICAL APPROACH
BUILDING 342, ORGANIZATIONAL MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-M9-01 GP-M9-02 GP-M9-03 GP-M9-04 GP-M9-05	* LOCATED AT, OR NEAR, VEHICLE GREASE RACKS, FORMER STORAGE PADS, STORM WATER CATCHMENT BASIN, AND THE PAINT STORAGE BUILDING
SOIL VAPOR SURVEY	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SV-M9-01 SV-M9-02 SV-M9-03 SV-M9-04 SV-M9-05 SV-M9-06	* LOCATED AT, OR NEAR, VEHICLE GREASE RACKS, FORMER STORAGE PADS, AND THE PAINT STORAGE BUILDING (BUILDING 367)
SURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SS-M9-01	* LOCATED BEHIND A NEW BERMED CONCRETE CONTAINMENT PAD FOR FUEL TRUCK PARKING
SOIL BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	SB-M9-01	* LOCATED BENEATH THE VEHICLE GREASE RACK IN THE NORTHEAST CORNER OF THE MOTOR POOL AREA AT OMS #9

TABLE 6-2
SUMMARY OF GEOPROBE BORINGS
BUILDING 342, ORGANIZATIONAL MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-M9-01	10	0 - 4			OH	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	OH	1230
GP-M9-02	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-M9-03	10	0 - 4			OH	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-M9-04	10	0 - 4			ML	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	OH	0
GP-M9-05	10	0 - 4			OH	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0

NOTES: 1.) Analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 6-3
SUMMARY OF SOIL BORINGS
BUILDING 342, ORGANIZATIONAL MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

SOIL BORING	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
SB-M9-01	12	0 - 2		OH	0
		5 - 7		OH	0
		10 - 12	10 - 12	OH	0

NOTES: AOC = Area of Concern
bgs = below ground surface
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 6-4
ANALYTES IN SURFACE SOIL
ORGANIZATIONAL MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INVESTIGATION
JUANA DIAZ, PUERTO RICO

Site ID:	**SS-M9-01**	
Field Sample Number:	**SM90101X**	
Sample Date:	**11/19/96**	
Depth (feet, bgs):	**1 ft**	
Units:	**µg/g**	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		
2,6,10,14-Tetramethylpentadecane	9	VS
Eicosane	5	VS
Heneicosane	5	VS
Heptadecane	9	VS
Hexadecane	10	VS
Nonadecane	9	VS
Octadecane	9	VS
Tetradecane	9	VS
Tricosane	9	VS
Tridecane	9	VS
Unknown Compound 539	4	VB
Unknown Compound 563	5	V
Unknown Compound 564	3	V
Unknown Compound 566	3	V
Unknown Compound 567	4	V
Unknown Compound 574	5	V
Unknown Compound 580	2	V
Unknown Compound 586	3	V
Unknown Compound 592	1	V
Unknown Compound 596	1	V
Unknown Compound 603	1	V
Unknown Compound 623	1	VB
OTHER		
Diesel Range Organics (DRO)	1260	V
Gasoline Range Organics (GRO)	10.6	V
INORGANICS		
Aluminum	15300	VB
Barium	66.8	V
Calcium	74200	V
Chromium	20	V
Cobalt	13.1	V
Copper	34.1	V
Iron	23500	VB
Lead	25	BV
Magnesium	11500	V
Manganese	698	VB
Nickel	25.4	V
Vanadium	72	V
Zinc	67.8	V

NOTES:

µg/g = micrograms per gram (or parts per million).
B = Analyte found in the method blank or QC blank as well as the sample.
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.
< = Less than the certified reporting limit.

TABLE 6-5
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
ORGANIZATIONAL MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Analytical Method	Site ID/Field ID: Field Sample Number: Depth (feet): Date Sampled:	GP-M9-01 PM90110X 6-10 11-15-1996	GP-M9-02 PM90210X 6-10 11-15-1996	GP-M9-03 PM90310X 6-10 11-15-1996	GP-M9-04 PM90410X 6-10 11-15-1996	GP-M9-05 PM90510X 6-10 11-16-1996
8260	1,1,1-Trichloroethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,1,2,2-Tetrachloroethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,1,2-Trichloroethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethene (total)	ND 500	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloropropane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	2-Butanone (MEK)	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	2-Hexanone	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	4-Methyl-2-pentanone (MIBK)	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	Acetone	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	Benzene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Bromodichloromethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Bromoform	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Bromomethane	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	Carbon disulfide	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Carbon tetrachloride	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Chlorobenzene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Chloroethane	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	Chloroform	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Chloromethane	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	cis-1,3-Dichloropropene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Dibromochloromethane	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Ethylbenzene	1700	ND 5	ND 5	ND 5	ND 5
8260	Methylene chloride	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Styrene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Tetrachloroethene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Toluene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	trans-1,3-Dichloropropene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Trichloroethene	ND 500	ND 5	ND 5	ND 5	ND 5
8260	Vinyl acetate	ND 1000				
8260	Vinyl chloride	ND 1000	ND 10	ND 10	ND 10	ND 10
8260	Xylenes (total)	1100	ND 5	ND 5	ND 5	ND 5
E413.1	Oil and Grease	ND 100	ND 100	ND 100	ND 100	ND 100

NOTES:

All concentrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).

ND = Not Detected above the indicated quantitation limit.

TABLE 6-6
ANALYTES IN SUBSURFACE SOIL - SOIL BORINGS
ORGANIZATION MAINTENANCE SHOP #9

FORT ALLEN PHASE I SITE INVESTIGATION
JUANA DIAZ, PUERTO RICO

Site ID:	SB-M9-01	
Field Sample Number:	BM90112X	
Sample Date:	11/19/96	
Depth (feet, bgs):	12	
Units:	µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		
Unknown Compound 537	.1	V
Unknown Compound 539	7	VB
Unknown Compound 551	.1	VB
Unknown Compound 606	.2	VB
Unknown Compound 614	.2	VB
Unknown Compound 615	.6	VB
Unknown Compound 623	9	VB
Unknown Compound 630	.09	VB
Unknown Compound 637	1	VB
Unknown Compound 664	.09	V
INORGANICS		
Aluminum	35700	VB
Arsenic	1.54	V
Barium	95	V
Beryllium	.437	V
Calcium	38200	V
Chromium	49.2	V
Cobalt	20.8	V
Copper	63	V
Iron	46500	VB
Lead	2.98	BV
Magnesium	20400	V
Manganese	961	VB
Nickel	33.7	V
Potassium	3190	V
Sodium	4520	V
Vanadium	148	V
Zinc	68.9	V

Notes:

µg/g = micrograms per gram (or parts per million.)
B = Analyte found in the method blank or QC blank as well as the sample.
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.

TABLE 7-1
SUMMARY OF TECHNICAL APPROACH
BUILDING 358, PAINT AND CHEMICAL STORAGE ROOM

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR ON-SITE AND OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-PC-01 GP-PC-02 GP-PC-03 GP-PC-04	* LOCATED AROUND THE PERIMETER OF BUILDING 358
SOIL VAPOR SURVEY	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SV-PC-01 SV-PC-02 SV-PC-03 SV-PC-04 SV-PC-05	* LOCATED AROUND THE PERIMETER OF BUILDING 358

TABLE 7-2
SUMMARY OF GEOPROBE BORINGS
BUILDING 358, PAINT AND CHEMICAL STORAGE ROOM

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-PC-01	10	0.25 - 1			CL	0
		1 - 4			CH	0
		6 - 10	6 - 10	Halog. VOCs, BTEX	CL	0
GP-PC-02	10	1 - 4			ML	0
		6 - 10	6 - 10	Halog. VOCs, BTEX	CL	0
GP-PC-03	10	1 - 4			ML	0
		6 - 10	6 - 10	Halog. VOCs, BTEX	OH	0
GP-PC-04	10	0 - 4			ML	0
		6 - 10	6 - 10	Halog. VOCs, BTEX	CL	0

NOTES: 1) Halogenated (Halog.) VOC analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies. BTEX analyses were conducted using immunoassay test kits.

AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 7-3
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
BUILDING 358, PAINT AND CHEMICAL STORAGE ROOM

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Analytical Method	Site ID/Field ID: Field Sample Number: Depth (feet): Date Sampled:	GP-PC-01 PPC0110X 6-10 11/13/96		GP-PC-02 PPC0210X 6-10 11/13/96		GP-PC-03 PPC0310X 6-10 11/13/96		GP-PC-04 PPC0410X 6-10 11/13/96	
8010	1,1,1-Trichloroethane	ND	50	ND	50	ND	50	ND	50
8010	1,1,2,2-Tetrachloroethane	ND	100	ND	100	ND	100	ND	100
8010	1,1,2-Trichloro-1,2,2-	ND	100	ND	100	ND	100	ND	100
8010	1,1,2-Trichloroethane	ND	100	ND	100	ND	100	ND	100
8010	1,1-Dichloroethane	ND	50	ND	50	ND	50	ND	50
8010	1,1-Dichloroethene	ND	50	ND	50	ND	50	ND	50
8010	1,2-Dichloroethane	ND	100	ND	100	ND	100	ND	100
8010	1,2-Dichloropropane	ND	100	ND	100	ND	100	ND	100
8010	Bromodichloromethane	ND	100	ND	100	ND	100	ND	100
8010	Bromoform	ND	500	ND	500	ND	500	ND	500
8010	Bromomethane	ND	500	ND	500	ND	500	ND	500
8010	Carbon tetrachloride	ND	50	ND	50	ND	50	ND	50
8010	Chlorobenzene	ND	200	ND	200	ND	200	ND	200
8010	Chloroethane	ND	500	ND	500	ND	500	ND	500
8010	Chloroform	ND	50	ND	50	ND	50	ND	50
8010	Chloromethane	ND	500	ND	500	ND	500	ND	500
8010	cis-1,2-Dichloroethene	ND	50	ND	50	ND	50	ND	50
8010	cis-1,3-Dichloropropene	ND	200	ND	200	ND	200	ND	200
8010	Dibromochloromethane	ND	100	ND	100	ND	100	ND	100
8010	EDB (1,2-Dibromoethane)	ND	200	ND	200	ND	200	ND	200
8010	Methylene chloride	ND	500	ND	500	ND	500	ND	500
8010	Tetrachloroethene	ND	50	ND	50	ND	50	ND	50
8010	trans-1,2-Dichloroethene	ND	50	ND	50	ND	50	ND	50
8010	trans-1,3-Dichloropropene	ND	100	ND	100	ND	100	ND	100
8010	Trichloroethene	ND	50	ND	50	ND	50	ND	50
8010	Vinyl chloride	ND	100	ND	100	ND	100	ND	100

NOTES: ND = Not detected above the indicated quantitation limit.
All concentrations are in micrograms per kilogram (µg/kg), or parts per billion (ppb)

TABLE 8-1
SUMMARY OF TECHNICAL APPROACH
BUILDING 360, PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR ON-SITE ANALYSIS BY IMMUNOASSAY TEST KITS * CHARACTERIZE SOIL	GP-PH-01 GP-PH-02 GP-PH-03	* LOCATED IN THE FORMER PESTICIDE/HERBICIDE MIXING AND STORAGE AREA
SOIL VAPOR SURVEY	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SV-PH-01 SV-PH-02 SV-PH-03 SV-PH-04	* LOCATED IN THE FORMER PESTICIDE/HERBICIDE MIXING AND STORAGE AREA
SOIL BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	SB-PH-01	* LOCATED IN THE FORMER PESTICIDE/HERBICIDE MIXING AND STORAGE AREA, WITHIN THE FOOTPRINT OF FORMER BUILDING 360

TABLE 8-2
SUMMARY OF GEOPROBE BORINGS
BUILDING 360, PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-PH-01	10	0 - 4	0 - 4	BTEX, PCBs, Chlordane, DDT	ML	0
		4 - 6			ML	0
		6 - 10			OH	0
GP-PH-02	10	0.25 - 4	0.25 - 4	BTEX, PCBs, Chlordane, DDT	ML	0
		4 - 6			CL	0
		6 - 10			CL	0
GP-PH-03	10	0.25 - 4	0.25 - 4	BTEX, PCBs, Chlordane, DDT	CL	0
		4 - 6			CL	0
		6 - 10			CL	0

NOTES: 1.) Analyses were performed on-site using immunoassay test kits.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 8-3
SUMMARY OF SOIL BORINGS
BUILDING 360, PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

SOIL BORING	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
SB-PH-01	12	0 - 2			0
		5 - 7		OH	0
		10 - 12	10 - 12	CL	0

NOTES: AOC = Area of Concern
bgs = below ground surface
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 8-4
ANALYTES IN SUBSURFACE SOIL-SOIL BORINGS
PESTICIDE/HERBICIDE MIXING AND STORAGE AREA

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	SB-PH-01	
Field Sample Number:	BPH0107X	
Sample Date:	11/19/96	
Depth (feet, bgs):	7	
Units:	µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (4,4'-DDE)	0.12	VS
Unknown Compound 539	7	VB
Unknown Compound 548	.1	V
Unknown Compound 551	.1	VB
Unknown Compound 556	.1	V
Unknown Compound 606	.2	VB
Unknown Compound 614	.2	VB
Unknown Compound 615	.7	VB
Unknown Compound 623	5	VB
UnknownCompound 632	.1	VB
Unknown Compound 637	1	VB
Unknown Compound 660	.4	V
INORGANICS		
Aluminum	27100	VB
Barium	114	V
Calcium	89400	V
Chromium	29.1	V
Cobalt	16.8	V
Copper	48.6	V
Iron	31400	VB
Lead	2.45	BV
Magnesium	18400	V
Manganese	926	VB
Nickel	20.3	V
Potassium	3080	V
Sodium	4880	V
Vanadium	122	V
Zinc	51.9	V

NOTES:

µg/g = micrograms per gram (or parts per million.)
B = Analyte found in the method blank or QC blank as well as the sample.
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.

TABLE 9-1
SUMMARY OF TECHNICAL APPROACH
LEAKING ELECTRICAL TRANSFORMER

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
SURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SS-LE-01 SS-LE-02	* ASSUMED TO BE LOCATION OF LEAKING ELECTRICAL TRANSFORMER IDENTIFIED BY 1984 AEHA REPORT * LOCATED ON EITHER SIDE OF A BANK OF THREE ELECTRICAL TRANSFORMERS

TABLE 9-2
ANALYTES IN SURFACE SOIL
LEAKING ELECTRICAL TRANSFORMER

FORT ALLEN PHASE I SITE INVESTIGATION
JUANA DIAZ, PUERTO RICO

Site ID:		SS-LE-01			SS-LE-02	
Field Sample Number:		SLE0101X			SLE0201X	
Sample Date:		11/19/96			11/19/96	
Depth (feet, bgs):		1			1	
Units:		µg/g			µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)						
1,2-Dimethylnaphthalene					.15	VS
4,4'-DDD		.19	VS			
4,4'-DDE		.55	VS			
N-Tetradecanoic Acid Amide		.17	VS			
Unknown Compound 539		6	VB		5	VB
Unknown Compound 551		.1	VB		.08	VB
Unknown Compound 594					.07	V
Unknown Compound 606					.2	VB
Unknown Compound 614		.3	VB		.2	VB
Unknown Compound 615		.5	VB		.5	VB
Unknown Compound 618					.1	V
Unknown Compound 623		7	VB		7	VB
Unknown Compound 630		.09	VB		.08	VB
Unknown Compound 637		1	VB		1	VB
Unknown Compound 659					.2	V
Unknown Compound 663					.08	V
Unknown Compound 668		.07	V		.08	V
OTHER						
Diesel Range Organics (DRO)		8.95	V		45.3	V
INORGANICS						
Aluminum		4200	VB		9360	VB
Barium	<	80	V		559	V
Calcium		360000	V		198000	V
Chromium	<	6	V		12	V
Cobalt	<	20	V		11.3	V
Copper	<	10	V		83.2	V
Iron		6800	VB		16300	VB
Lead		79	BV		1300	BV
Magnesium		11000	V		10100	V
Manganese		230	VB		550	VB
Mercury	<	.2	V		.261	V
Nickel	<	16	V		11.6	V
Vanadium	<	20	V		36.4	V
Zinc		140	V		697	V

NOTES:

µg/g = micrograms per gram (or parts per million).
B = Analyte found in the method blank or QC blank as well as the sample.
bgs = below ground surface
V = Sample subjected to unusual storage/preservation conditions.
< = Less than the certified reporting limit.

TABLE 12-1
SUMMARY OF TECHNICAL APPROACH
WASTEWATER TREATMENT PLANT

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-WW-01 GP-WW-02 GP-WW-03 GP-WW-04 GP-WW-05 GP-WW-06	* LOCATED NEAR DISCHARGE PIPE CONNECTION TO WWTP, AND IN DRAINAGE SWALE WHICH FORMERLY RECEIVED DISCHARGE DURING TREATMENT PLANT OVERFLOW
SOIL VAPOR SURVEY	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SV-WW-01 SV-WW-02 SV-WW-03	* LOCATED NEAR DISCHARGE PIPE CONNECTION TO WWTP, AND IN DRAINAGE SWALE WHICH FORMERLY RECEIVED DISCHARGE DURING TREATMENT PLANT OVERFLOW
SURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SS-WW-01	* LOCATED IN DRAINAGE SWALE WHICH FORMERLY RECEIVED DISCHARGE DURING TREATMENT PLANT OVERFLOW

TABLE 12-2
SUMMARY OF GEOPROBE BORINGS
WASTEWATER TREATMENT PLANT

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-WW-01	10	0 - 4			OH	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-WW-02	10	0 - 4			ML	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-WW-03	10	0 - 4	0 - 4	VOCs, Oil & Grease	CL	0
		4 - 6			ML	0
		6 - 10			ML	0
GP-WW-04	10	0 - 4			CL	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-WW-05	10	0 - 4			ML	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-WW-06	10	0 - 4			CL	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0

NOTES: 1.) Analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System

TABLE 12-3
ANALYTES IN SURFACE SOIL
WASTEWATER TREATMENT PLANT

FORT ALLEN PHASE I SITE INVESTIGATION
JUANA DIAZ, PUERTO RICO

Site ID:	SS-WW-01	
Field Sample Number:	SWW0102X	
Sample Date:	11/19/96	
Depth (feet, bgs):	2	
Units:	µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		
Unknown Compound 539	6	VB
Unknown Compound 551	.1	VB
Unknown Compound 606	.2	VB
Unknown Compound 614	.3	VB
Unknown Compound 615	.5	VB
Unknown Compound 623	7	VB
Unknown Compound 630	.1	VB
Unknown Compound 637	2	VB
Unknown Compound 640	.09	V
Unknown Compound 660	1	V
Unknown Compound 671	.2	V
OTHER		
Diesel Range Organics (DRO)	16	V
INORGANICS		
Aluminum	26300	VB
Barium	121	V
Calcium	38500	V
Chromium	49.2	V
Cobalt	24.5	V
Copper	53.7	V
Iron	40000	VB
Lead	22.6	BV
Magnesium	15300	V
Manganese	1100	VB
Nickel	46.8	V
Potassium	3410	V
Vanadium	128	V
Zinc	69.2	V

NOTES:

µg/g = micrograms per gram (or parts per million).
B = Analyte found in the method blank or QC blank as well as the sample.
bgs = below ground surface
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.

TABLE 12-4
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
WASTEWATER TREATMENT PLANT

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

	Site ID/Field ID:	GP-WW-01	GP-WW-02	GP-WW-03	GP-WW-04	GP-WW-05	GP-WW-06
	Field Sample Number:	PWW0110X	PWW0210X	PWW0304X	PWW0410X	PWW0510X	PWW0610X
Analytical	Depth (feet):	6-10	6-10	4-8	6-10	6-10	6-10
Method	Date Sampled:	11-16-1996	11-16-1996	11-17-1996	11-16-1996	11-16-1996	11-16-1996
8260	1,1,1-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1,2,2-Tetrachloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1,2-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethene (total)	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloropropane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	2-Butanone (MEK)	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	2-Hexanone	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	4-Methyl-2-pentanone (MIBK)	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Acetone	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Benzene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromodichloromethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromoform	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromomethane	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Carbon disulfide	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Carbon tetrachloride	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chlorobenzene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chloroethane	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Chloroform	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chloromethane	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	cis-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Dibromochloromethane	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Ethylbenzene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Methylene chloride	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Styrene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Tetrachloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Toluene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	trans-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Trichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Vinyl chloride	ND 10	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Xylenes (total)	ND 5	ND 5	ND 5	ND 5	ND 5	ND 5
E413.1	Oil and Grease	ND 100	ND 100	ND 100	ND 100	ND 100	ND 100

NOTES:

All concentrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).

ND = Not Detected above the indicated quantitation limit.

TABLE 13-1
SUMMARY OF TECHNICAL APPROACH
AOC 3

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-03-01 GP-03-02 GP-03-03 GP-03-04 GP-03-05	* ADJACENT TO THE SOUTHERN PERIMETER OF A POSSIBLE TRENCHED AREA IDENTIFIED IN A 1967 AERIAL PHOTOGRAPH
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-03-06 GP-03-07 GP-03-08 GP-03-09 GP-03-10	* ADJACENT TO THE SOUTHERN PERIMETER OF A POSSIBLE TRENCHED AREA IDENTIFIED IN 1962 AND 1967 AERIAL PHOTOGRAPHS
MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING	* MONITOR GROUNDWATER LEVELS * MONITOR GROUNDWATER QUALITY * CHARACTERIZE SOIL	MW-03-01 MW-03-02	* APPARENT DOWNGRADIENT LOCATIONS FROM POSSIBLE TRENCHES IDENTIFIED IN 1962, 1963 AND 1967 AERIAL PHOTOGRAPHS AND THE RCRA LANDFILL * DOWNGRADIENT GROUNDWATER QUALITY

TABLE 13-2
SUMMARY OF GEOPROBE BORINGS
AOC 3

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-03-01	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-02	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-03	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-04	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-05	10	0 - 4			CL	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-06	10	0 - 4			OH	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-07	10	0 - 4			ML	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-08	10	0 - 4			ML	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-09	10	0 - 4			CL	0
		4 - 6			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-03-10	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0

NOTES: 1.) Analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 13-3
MONITORING WELL COMPLETION DETAILS
AOC 3

FORT ALLEN SITE INSPECTION
JUANA DIAZ, PUERTO RICO

MONITORING WELL	SOIL DRILLING METHOD	BEDROCK DRILLING METHOD	MEDIA SCREENED	WELL SCREEN DEPTH (feet, bgs)	WELL SCREEN DEPTH (meters, bgs)	WELL SCREEN ELEVATION (feet, msl)	WELL SCREEN ELEVATION (meters, msl)	MATERIAL
MW-03-01	HSA	NA	SOIL	25 - 40	7.62 - 12.19	27.66 - 12.66	8.43 - 3.86	2" ID PVC
MW-03-02	HSA	NA	SOIL	21 - 36	6.40 - 10.97	26.53 - 11.54	8.09 - 3.52	2" ID PVC

NOTES: HSA = hollow-stem auger
ID = inside diameter
msl = mean sea level
NA = Not Applicable
PVC = polyvinyl chloride

TABLE 13-4
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
AOC 3

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Analytical Method	Site ID/Field ID: Field Sample Number: Depth (feet): Date Sampled:	GP-03-01 PO30110X 6-10 11-14-1996	GP-03-02 PO30210X 6-10 11-14-1996	GP-03-03 PO30310X 6-10 11-14-1996	GP-03-04 PO30410X 6-10 11-14-1996	GP-03-05 PO30510X 6-10 11-15-1996	Analytical Method
8260	1,1,1-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,1,2,2-Tetrachloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,1,2-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,1-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,1-Dichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,2-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,2-Dichloroethene (total)	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	1,2-Dichloropropane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	2-Butanone (MEK)	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	2-Hexanone	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	4-Methyl-2-pentanone (MIBK)	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	Acetone	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	Benzene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Bromodichloromethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Bromoform	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Bromomethane	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	Carbon disulfide	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Carbon tetrachloride	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Chlorobenzene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Chloroethane	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	Chloroform	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Chloromethane	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	cis-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Dibromochloromethane	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Ethylbenzene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Methylene chloride	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Styrene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Tetrachloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Toluene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	trans-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Trichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5	8260
8260	Vinyl chloride	ND 10	ND 10	ND 10	ND 10	ND 10	8260
8260	Xylenes (total)	ND 5	ND 5	ND 5	ND 5	ND 5	8260
E413.1	Oil and Grease	ND 100	ND 100	ND 100	ND 100	ND 100	E413.1

NOTE: All concentrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).
ND = Not Detected above the indicated quantitation limit.

NOTE: All con

TABLE 13-4
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
AOC 3

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID/Field ID: Field Sample Number: Depth (feet): Date Sampled:	GP-03-06 PO30610X 6-10 11-15-1996	GP-03-07 PO30710X 6-10 11-15-1996	GP-03-08 PO30810X 6-10 11-15-1996	GP-03-09 PO30910X 6-10 11-15-1996	GP-03-10 PO31010X 6-10 11-15-1996
1,1,1-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
1,1,2,2-Tetrachloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
1,1,2-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
1,1-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
1,1-Dichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
1,2-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
1,2-Dichloroethene (total)	ND 5	ND 5	ND 5	ND 5	ND 5
1,2-Dichloropropane	ND 5	ND 5	ND 5	ND 5	ND 5
2-Butanone (MEK)	ND 10	ND 10	ND 10	ND 10	ND 10
2-Hexanone	ND 10	ND 10	ND 10	ND 10	ND 10
4-Methyl-2-pentanone (MIBK)	ND 10	ND 10	1.1 J	ND 10	ND 10
Acetone	ND 10	ND 10	ND 10	ND 10	ND 10
Benzene	ND 5	ND 5	ND 5	ND 5	ND 5
Bromodichloromethane	ND 5	ND 5	ND 5	ND 5	ND 5
Bromoform	ND 5	ND 5	ND 5	ND 5	ND 5
Bromomethane	ND 10	ND 10	ND 10	ND 10	ND 10
Carbon disulfide	ND 5	ND 5	ND 5	ND 5	ND 5
Carbon tetrachloride	ND 5	ND 5	ND 5	ND 5	ND 5
Chlorobenzene	ND 5	ND 5	ND 5	ND 5	ND 5
Chloroethane	ND 10	ND 10	ND 10	ND 10	ND 10
Chloroform	ND 5	ND 5	ND 5	ND 5	ND 5
Chloromethane	ND 10	ND 10	ND 10	ND 10	ND 10
cis-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5
Dibromochloromethane	ND 5	ND 5	ND 5	ND 5	ND 5
Ethylbenzene	ND 5	ND 5	ND 5	ND 5	ND 5
Methylene chloride	ND 5	ND 5	ND 5	ND 5	ND 5
Styrene	ND 5	ND 5	ND 5	ND 5	ND 5
Tetrachloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
Toluene	ND 5	ND 5	ND 5	ND 5	ND 5
trans-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5
Trichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
Vinyl chloride	ND 10	ND 10	ND 10	ND 10	ND 10
Xylenes (total)	ND 5	ND 5	ND 5	ND 5	ND 5
Oil and Grease	ND 100	ND 100	ND 100	ND 100	ND 100

centrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).

TABLE 13-5
ANALYTES IN GROUNDWATER
AOC 3

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	MW-03-01	MW-03-02
Field Sample Number:	M030126X	M030222X
Sample Date:	12/04/96	12/04/96
Depth (feet,bgs):	26	22
Units:	µg/L	µg/L
VOLATILE ORGANIC COMPOUNDS (VOCs)		
Acetone	5.4	< 5
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)		
Unknown Compound 550		30
Unknown Compound 552		10
Unknown Compound 616		20
Unknown Compound 249		1
OTHER		
Diesel Range Organics (DRO)	< 100	250
INORGANICS		
Aluminum	< 200	6290
Calcium	80100	51200
Iron	< 100	7070
Magnesium	21800	14700
Manganese	< 15	183
Sodium	62100	96500
Zinc	< 20	20.6

NOTES:

bgs = below ground surface
µg/L = micrograms per Liter (or parts per billion).
< = Less than the certified reporting limit.

TABLE 14-1
SUMMARY OF TECHNICAL APPROACH
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-08-01 GP-08-02	* ADJACENT TO TWO PVC PIPES (DRAINS) IN CONCRETE PAD SOUTH OF AOC 8
SOIL VAPOR SURVEY	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SV-08-01 SV-08-02	* ADJACENT TO TWO PVC PIPES (DRAINS) IN CONCRETE PAD SOUTH OF AOC 8
SOIL BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	SB-08-01 SB-08-02	* LOCATED IN UNVEGETATED SOIL AREAS WITHIN THE BOUNDARY OF AOC 8, WHERE RUNOFF FROM THE CONCRETE PAD ACCUMULATES
MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING	* MONITOR GROUNDWATER LEVELS * MONITOR GROUNDWATER QUALITY * CHARACTERIZE SOIL	MW-08-01	* APPARENT DOWNGRADIENT LOCATION FROM AOC 8 * DOWNGRADIENT GROUNDWATER QUALITY

TABLE 14-2
SUMMARY OF GEOPROBE BORINGS
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-08-01	10	0 - 4			OH	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-08-02	10	0 - 4			CL	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0

NOTES: 1.) Analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 14-3
SUMMARY OF SOIL BORINGS
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

SOIL BORING	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
SB-08-01	12	0 - 2		ML	0
		5 - 7		ML	0
		10 - 12	10 - 12	ML	0
SB-08-02	12	0 - 2		ML	0
		5 - 7		ML	0
		10 - 12	10 - 12	CL	0

NOTES: AOC = Area of Concern
bgs = below ground surface
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 14-4
MONITORING WELL COMPLETION DETAILS
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

MONITORING WELL	SOIL DRILLING METHOD	BEDROCK DRILLING METHOD	MEDIA SCREENED	WELL SCREEN DEPTH (feet, bgs)	WELL SCREEN DEPTH (meters, bgs)	WELL SCREEN ELEVATION (feet, msl)	WELL SCREEN ELEVATION (meters, msl)	MATERIAL
MW-08-01	HSA	NA	SOIL	15 - 30	4.57 - 9.14	17.45 - 2.46	5.32 - 0.75	2" ID PVC

NOTES: HSA = hollow-stem auger
ID = inside diameter
msl = mean sea level
NA - Not Applicable
PVC = polyvinyl chloride

TABLE 14-5
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Analytical Method	Site ID/Field ID: Field Sample Number: Depth (feet): Date Sampled:	GP-08-01 P080110X 6-10 11-16-1996		GP-08-02 PO80210X 6-10 11-16-1996	
8260	1,1,1-Trichloroethane	ND	5	ND	5
8260	1,1,2,2-Tetrachloroethane	ND	5	ND	5
8260	1,1,2-Trichloroethane	ND	5	ND	5
8260	1,1-Dichloroethane	ND	5	ND	5
8260	1,1-Dichloroethene	ND	5	ND	5
8260	1,2-Dichloroethane	ND	5	ND	5
8260	1,2-Dichloroethene (total)	ND	5	ND	5
8260	1,2-Dichloropropane	ND	5	ND	5
8260	2-Butanone (MEK)	ND	10	ND	10
8260	2-Hexanone	ND	10	ND	10
8260	4-Methyl-2-pentanone (MIBK)	ND	10	ND	10
8260	Acetone	ND	10	ND	10
8260	Benzene	ND	5	ND	5
8260	Bromodichloromethane	ND	5	ND	5
8260	Bromoform	ND	5	ND	5
8260	Bromomethane	ND	10	ND	10
8260	Carbon disulfide	ND	5	ND	5
8260	Carbon tetrachloride	ND	5	ND	5
8260	Chlorobenzene	ND	5	ND	5
8260	Chloroethane	ND	10	ND	10
8260	Chloroform	ND	5	ND	5
8260	Chloromethane	ND	10	ND	10
8260	cis-1,3-Dichloropropene	ND	5	ND	5
8260	Dibromochloromethane	ND	5	ND	5
8260	Ethylbenzene	ND	5	ND	5
8260	Methylene chloride	ND	5	ND	5
8260	Styrene	ND	5	ND	5
8260	Tetrachloroethene	ND	5	ND	5
8260	Toluene	ND	5	ND	5
8260	trans-1,3-Dichloropropene	ND	5	ND	5
8260	Trichloroethene	ND	5	ND	5
8260	Vinyl chloride	ND	10	ND	10
8260	Xylenes (total)	ND	5	ND	5
E413.1	Oil and Grease	ND	100	ND	100

NOTES:

All concentrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).

ND = Not detected above the indicated quantitation limit.

TABLE 14-6
ANALYTES IN SUBSURFACE SOIL - SOIL BORINGS
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	SB-08-01			SB-08-02	
Field Sample Number:	BO80112X			BO80212X	
Sample Date:	11/19/96			11/19/96	
Depth (feet, bgs):	12			12	
Units:	µg/g			µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)					
Unknown Compound 537	.09	V			
Unknown Compound 539	6	VB		6	VB
Unknown Compound 548				.1	V
Unknown Compound 549				.09	V
Unknown Compound 551	.1	VB		.09	VB
Unknown Compound 606				.1	VB
Unknown Compound 614	.08	VB		.1	VB
Unknown Compound 615	.2	VB		.4	VB
Unknown Compound 623	4	VB		6	VB
Unknown Compound 637	1	VB		1	VB
INORGANICS					
Aluminum	24300	VB		24300	VB
Arsenic	2.57	V		2.32	V
Barium	152	V		169	V
Beryllium	.316	V		.428	V
Calcium	14000	V		13600	V
Chromium	62.8	V		48.8	V
Cobalt	251	V		26.2	V
Copper	48.5	V		56.2	V
Iron	47100	VB		40700	VB
Lead	2.55	BV		2.13	BV
Magnesium	17500	V		17800	V
Manganese	957	VB		1410	VB
Nickel	34.7	V		45.7	V
Silver	44.1	V	<	2	V
Sodium	1350	V		4500	V
Vanadium	192	V		131	V
Zinc	69.8	V		67.7	V

NOTES:
bgs = below ground surface
µg/g = micrograms per gram (or parts per million.)
B = Analyte found in the method blank or QC blank as well as the sample.
V = Sample subjected to unusual storage/preservation conditions.
< = Less than the certified reporting limit.

TABLE 14-7
ANALYTES IN GROUNDWATER
AOC 8

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	MW-08-01
Field Sample Number:	M080120X
Sample Date:	12/03/96
Depth (feet)bgs:	20
Unit:	µg/L
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)	
Unknown Compound 052	2
INORGANICS	
Aluminum	2750
Calcium	76800
Iron	1600
Magnesium	20300
Manganese	144
Sodium	63400

NOTES:

bgs = below ground surface
µg/L = micrograms per Liter (or parts per billion).
< = Less than the certified reporting limit.

TABLE 15-1
SUMMARY OF TECHNICAL APPROACH
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

ACTIVITY	PURPOSE	SITE IDENTIFICATION	RATIONALE FOR SELECTED LOCATIONS
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-09-01 GP-09-02 GP-09-03 GP-09-04	* LOCATED AROUND THE PERIMETER OF A POTENTIAL TRENCHED AREA, IDENTIFIED IN 1951 AERIAL PHOTOGRAPH, AND LOCATED IN THE SOUTHEAST CORNER OF AOC 9
GEOPROBE BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	GP-09-05 GP-09-06 GP-09-07 GP-09-08	* LOCATED IN POTENTIAL DUMPING (LIGHT-TONED) AREA, IDENTIFIED IN 1951 AERIAL PHOTOGRAPH. AND LOCATED IN THE SOUTHEAST CORNER OF AOC 9
SOIL BORINGS AND SUBSURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS * CHARACTERIZE SOIL	SB-09-01 SB-09-02 SB-09-02 SB-09-02	* LOCATED IN POTENTIAL DUMPING AND TRENCHED AREAS IDENTIFIED IN 1951AERIAL PHOTOGRAPH
SURFACE SOIL SAMPLING	* COLLECT SAMPLES FOR OFF-SITE LABORATORY ANALYSIS	SS-09-01 SS-09-02	* LOCATED IN POTENTIAL DUMPING AREAS IDENTIFIED IN 1951 AERIAL PHOTOGRAPH. AND LOCATED IN THE NORTHWEST AND SOUTHWEST CORNERS OF AOC 9
MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING	* MONITOR GROUNDWATER LEVELS * MONITOR GROUNDWATER QUALITY * CHARACTERIZE SOIL	MW-09-01	* APPARENT DOWNGRADIENT LOCATION FROM AOC 9 * DOWNGRADIENT GROUNDWATER QUALITY

TABLE 15-2
SUMMARY OF GEOPROBE BORINGS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

GEOPROBE EXPLORATION ID	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	ANALYSES PERFORMED[1]	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
GP-09-01	10	0 - 4			ML	0
		6 - 10	6 - 10	VOCs, Oil & Grease	OH	0
GP-09-02	10	0 - 4			CL	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	OH	0
GP-09-03	10	0 - 4			CL	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	OH	0
GP-09-04	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-09-05	10	0 - 4			CL	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-09-06	10	0 - 4			CL	0
		4 - 6			SM	0
		6 - 10	6 - 10	VOCs, Oil & Grease	ML	0
GP-09-07	10	0 - 4			OH	0
		4 - 6			OH	0
		6 - 10	6 - 10	VOCs, Oil & Grease	CL	0
GP-09-08	10	0 - 4			ML	0
		4 - 6			CL	0
		6 - 10	6 - 10	VOCs, Oil & Grease	SC	0

NOTES: 1.) Analyses were performed by an off-site analytical laboratory using USEPA Level II methodologies.
AOC = Area of Concern
bgs = below ground surface
BTEX = total benzene, toluene, ethylbenzene and xylenes
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 15-3
SUMMARY OF SOIL BORINGS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

SOIL BORING	COMPLETION DEPTH (feet, bgs)	REFERENCE SAMPLE INTERVALS (feet, bgs)	ANALYTICAL SAMPLES INTERVAL (feet,bgs)	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)
SB-09-01	12	0 - 2		OH	0
		5 - 7		OH	0
		10 - 12	10 - 12	CL	0
SB-09-02	12	0 - 2		OH	0
		5 - 7		CL	0
		10 - 12	10 - 12	ML	0
SB-09-03	12	0 - 2		OH	0
		5 - 7		CL	0
		10 - 12	10 - 12	CL	0
SB-09-04	12	0 - 2		OH	0
		5 - 7		ML	0
		10 - 12	10 - 12	ML	0

NOTES: AOC = Area of Concern
bgs = below ground surface
PID = photoionization detector
ppm = parts per million by volume
USCS = Unified Soil Classification System
VOCs = volatile organic compounds

TABLE 15-4
MONITORING WELL COMPLETION DETAILS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

MONITORING WELL	SOIL DRILLING METHOD	BEDROCK DRILLING METHOD	MEDIA SCREENED	WELL SCREEN DEPTH (feet, bgs)	WELL SCREEN DEPTH (meters, bgs)	WELL SCREEN ELEVATION (feet, msl)	WELL SCREEN ELEVATION (meters, msl)	MATERIAL
MW-09-01	HSA	NA	SOIL	10 - 25	3.05 - 7.62	19.12 - 4.13	5.83 - 1.26	2" ID PVC

NOTES: HSA = hollow-stem auger
ID = inside diameter
msl = mean sea level
NA - Not Applicable
PVC = polyvinyl chloride

TABLE 15-5
ANALYTES IN SURFACE SOIL
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	SS-09-01			SS-09-02		
Field Sample Number:	SO90101X			SO90201X		
Sample Date:	11/19/96			11/19/96		
Depth (feet, bgs):	1			1		
Units:	μg/g			μg/g		
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)						
Octadecane		.21	VS			
2,4-Bis(isopropylamino)-6-methoxy-1,3,5-triazine		.15	VS			
Unknown Compound 539		6	VB	6	VB	
Unknown Compound 551		.1	VB	.09	VB	
Unknown Compound 563						
Unknown Compound 591		.1	V			
Unknown Compound 605		.1	V			
Unknown Compound 606		.3	VB	.09	VB	
Unknown Compound 613		.2	V			
Unknown Compound 614		.3	VB	.1	VB	
Unknown Compound 615		.5	VB	.4	VB	
Unknown Compound 623		.4	VB	7	VB	
Unknown Compound 630		.1	VB			
Unknown Compound 637		1	VB	.8	VB	
Unknown Compound 640		.09	V			
Unknown Compound 647		.2	V			
Unknown Compound 658		.09	V			
Unknown Compound 659		.2	V			
Unknown Compound 660				1	V	
Unknown Compound 663		.2	V			
OTHER						
Diesel Range Organics (DRO)		18.6	V	6.74	V	
INORGANICS						
Aluminum		21800	VB	27300	VB	
Barium		154	V	159	V	
Calcium		102000	V	57800	V	
Chromium		28.3	V	41.7	V	
Cobalt		18.4	V	21.1	V	
Copper		56.3	V	68.5	V	
Iron		27900	VB	36100	VB	
Lead		32	BV	3.23	BV	
Magnesium		22500	V	24500	V	
Manganese		980	VB	585	VB	
Nickel		35.4	V	42.2	V	
Potassium	<	1000	V	1390	V	
Sodium	<	1000	V	6120	V	
Vanadium		71.4	V	129	V	
Zinc		63.8	V	54.7	V	

Notes:
bgs = below ground surface
μg/g = micrograms per gram (or parts per million).
B = Analyte found in the method blank or QC blank as well as the sample.
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.
< = Less than the certified reporting limit.

TABLE 15-6
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

	Site ID/Field ID:	GP-09-01	GP-09-02	GP-09-03	GP-09-04	GP-09-05
	Field Sample Number:	PO90110X	PO90210X	PO90310X	PO90410X	PO90510X
Analytical	Depth (feet):	6-10	6-10	6-10	6-10	6-10
Method	Date Sampled:	11-13-1996	11-13-1996	11-14-1996	11-14-1996	11-14-1996
8260	1,1,1-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1,2,2-Tetrachloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1,2-Trichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,1-Dichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloroethene (total)	ND 5	ND 5	ND 5	ND 5	ND 5
8260	1,2-Dichloropropane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	2-Butanone (MEK)	ND 10	ND 10	ND 10	ND 10	ND 10
8260	2-Hexanone	ND 10	ND 10	ND 10	ND 10	ND 10
8260	4-Methyl-2-pentanone (MIBK)	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Acetone	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Benzene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromodichloromethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromoform	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Bromomethane	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Carbon disulfide	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Carbon tetrachloride	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chlorobenzene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chloroethane	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Chloroform	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Chloromethane	ND 10	ND 10	ND 10	ND 10	ND 10
8260	cis-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Dibromochloromethane	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Ethylbenzene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Methylene chloride	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Styrene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Tetrachloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Toluene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	trans-1,3-Dichloropropene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Trichloroethene	ND 5	ND 5	ND 5	ND 5	ND 5
8260	Vinyl chloride	ND 10	ND 10	ND 10	ND 10	ND 10
8260	Xylenes (total)	ND 5	ND 5	ND 5	ND 5	ND 5
E413.1	Oil and Grease	ND 100	ND 100	ND 100	ND 100	ND 100

NOTES:

All concentrations are in µg/kg (parts per billion), except oil and grease which is in mg/kg (parts per million).

ND = Not detected above the indicated quantitation limit.

TABLE 15-6
LEVEL II SUBSURFACE SOIL ANALYTICAL DATA - GEOPROBE BORINGS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Analytical Method	Site ID/Field ID: / Field Sample Number: / Depth (feet): / Date Sampled:	GP-09-06 / PO90610X / 6-10 / 11-14-1996		GP-09-07 / PO90710X / 6-10 / 11-14-1996		GP-09-08 / PO90810X / 6-10 / 11-14-1996	
8260	1,1,1-Trichloroethane	ND	5	ND	5	ND	5
8260	1,1,2,2-Tetrachloroethane	ND	5	ND	5	ND	5
8260	1,1,2-Trichloroethane	ND	5	ND	5	ND	5
8260	1,1-Dichloroethane	ND	5	ND	5	ND	5
8260	1,1-Dichloroethene	ND	5	ND	5	ND	5
8260	1,2-Dichloroethane	ND	5	ND	5	ND	5
8260	1,2-Dichloroethene (total)	ND	5	ND	5	ND	5
8260	1,2-Dichloropropane	ND	5	ND	5	ND	5
8260	2-Butanone (MEK)	ND	10	ND	10	ND	10
8260	2-Hexanone	ND	10	ND	10	ND	10
8260	4-Methyl-2-pentanone (MIBK)	ND	10	ND	10	ND	10
8260	Acetone	ND	10	ND	10	ND	10
8260	Benzene	ND	5	ND	5	ND	5
8260	Bromodichloromethane	ND	5	ND	5	ND	5
8260	Bromoform	ND	5	ND	5	ND	5
8260	Bromomethane	ND	10	ND	10	ND	10
8260	Carbon disulfide	ND	5	ND	5	ND	5
8260	Carbon tetrachloride	ND	5	ND	5	ND	5
8260	Chlorobenzene	ND	5	ND	5	ND	5
8260	Chloroethane	ND	10	ND	10	ND	10
8260	Chloroform	ND	5	ND	5	ND	5
8260	Chloromethane	ND	10	ND	10	ND	10
8260	cis-1,3-Dichloropropene	ND	5	ND	5	ND	5
8260	Dibromochloromethane	ND	5	ND	5	ND	5
8260	Ethylbenzene	ND	5	ND	5	ND	5
8260	Methylene chloride	ND	5	ND	5	ND	5
8260	Styrene	ND	5	ND	5	ND	5
8260	Tetrachloroethene	ND	5	ND	5	ND	5
8260	Toluene	ND	5	ND	5	ND	5
8260	trans-1,3-Dichloropropene	ND	5	ND	5	ND	5
8260	Trichloroethene	ND	5	ND	5	ND	5
8260	Vinyl chloride	ND	10	ND	10	ND	10
8260	Xylenes (total)	ND	5	ND	5	ND	5
E413.1	Oil and Grease	ND	100	ND	100	ND	100

TABLE 15-7
ANALYTES IN SUBSURFACE SOIL - SOIL BORINGS
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	SB-09-01		SB-09-02		SB-09-03		SB-09-04	
Field Sample Number:	BO90112X		BO90212X		BO90312X		BO90412X	
Sample Date:	11/18/96		11/18/96		11/18/96		11/18/96	
Depth (feet, bgs):	12		12		12		12	
Units:	µg/g		µg/g		µg/g		µg/g	
SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)								
Bis(2-ethylhexyl)phthalate	.46	V	.58	V	< .33	V	< .33	V
2,4-Bis(isopropylamino)-6-methoxy-1,3,5-triazine	.32	VS						
Unknown Compound 537	.1	V	.1	V	.09	V		
Unknown Compound 539	7	VB	10	VB	6	VB	5	VB
Unknown Compound 544			.08	V				
Unknown Compound 547			.09	V				
Unknown Compound 548	.09	V	.1	V				
Unknown Compound 549	.1	V	.1	V				
Unknown Compound 551	.1	VB	.1	VB				
Unknown Compound 596			.2	V				
Unknown Compound 606			.2	VB				
Unknown Compound 607	.1	V						
Unknown Compound 614	.2	VB	.3	VB	.1	VB	.08	VB
Unknown Compound 615	.5	VB	.8	VB	.4	VB	.3	VB
Unknown Compound 623	7	VB	8	VB	6	VB	7	VB
Unknown Compound 637	1	VB	2	VB	1	VB	.8	VB
OTHER								
Diesel Range Organics (DRO)	6.71	V	< 4	V	< 4	V	< 4	V
INORGANICS								
Aluminum	25200	VB	20800	VB	23700	VB	29300	VB
Arsenic	< 5	V	< 5	V	2.4	V	< 5	V
Barium	132	V	337	V	156	V	401	V
Beryllium	< 1	V	< 1	V	.391	V	< 1	V
Calcium	23200	V	89500	V	27000	V	42900	V
Chromium	36.6	V	29.6	V	46.5	V	31.5	V
Cobalt	24.8	V	24.2	V	22.1	V	26.2	V
Copper	55.2	V	49.9	V	55.9	V	49.4	V
Iron	33800	VB	29800	VB	37100	VB	44300	VB
Lead	2.92	BV	2.71	BV	2.55	BV	2.37	BV
Magnesium	20600	V	16800	V	18500	V	16700	V
Manganese	846	VB	2080	VB	614	VB	1880	VB
Nickel	31.4	V	34.3	V	38	V	23.3	V
Potassium	1660	V	< 1000	V	< 1000	V	< 1000	V
Vanadium	114	V	95.4	V	124	V	162	V
Zinc	58.5	V	51.9	V	58.9	V	61.1	V

Notes:
bgs = below ground surface
µg/g = micrograms per gram (or parts per million.)
B = Analyte found in the method blank or QC blank as well as the sample.
S = Non-target compound analyzed for and detected.
V = Sample subjected to unusual storage/preservation conditions.
< = Less than the certified reporting limit.

TABLE 15-8
ANALYTES IN GROUNDWATER
AOC 9

FORT ALLEN PHASE I SITE INSPECTION
JUANA DIAZ, PUERTO RICO

Site ID:	**MW-09-01**
Field Sample Number:	**M090113X**
Sample Date:	**12/04/96**
Depth (feet,bgs):	**13**
Units:	**µg/L**
INORGANICS	
Calcium	89500
Magnesium	34000
Sodium	56200

NOTES:

bgs = below ground surface
µg/L = micrograms per Liter (or parts per billion).